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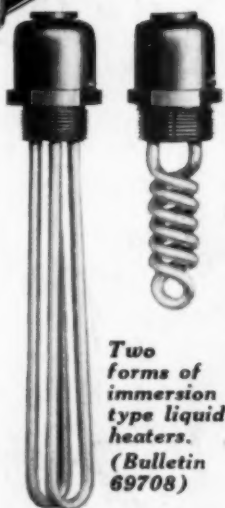
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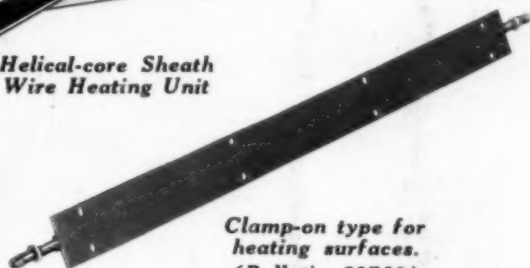
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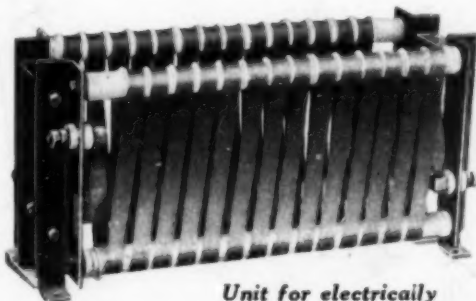
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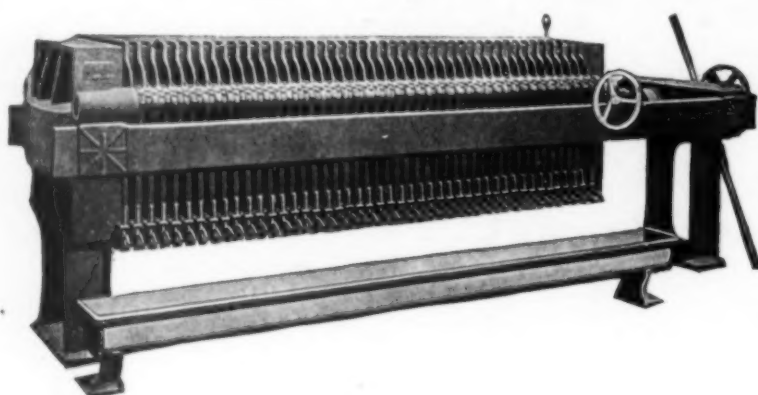
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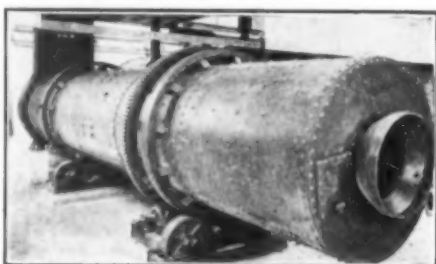
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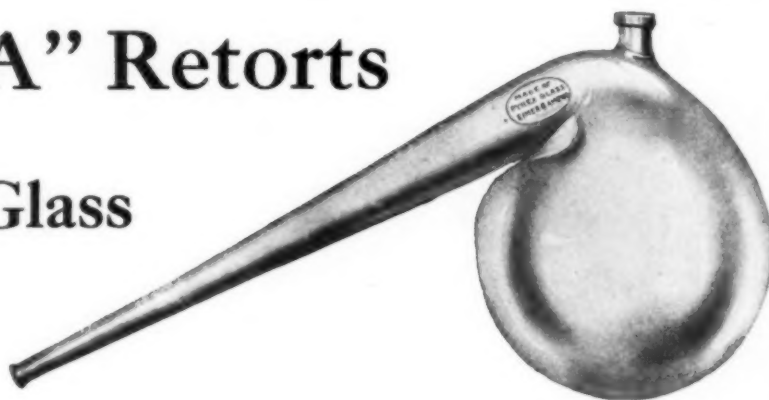
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Number 19

The Arms Conference And Chemical Warfare

CHEMICAL warfare is certain to come in for an exhaustive discussion at the Conference on the Limitation of Armament, which opens this week in Washington. It is admitted generally that the universal recognition of gas as a proper weapon would make it possible for armaments to be limited to a far greater extent than would be the case otherwise. Without discounting in any way its effectiveness as a weapon of offense, gas is coming to be regarded as one of the most potent of the weapons of defense.

An indication of the recognition of the importance of chemical warfare in any discussion of armaments is the selection of General AMOS A. FRIES, head of the Chemical Warfare Service of the Army, as a member of the technical staff of the American delegation. Further recognition of the chemical industry is had in the appointment of Dr. EDGAR F. SMITH, president of the American Chemical Society, as representative of the scientific and professional element, and of WILLIAM S. CULBERTSON, the Tariff Commissioner who has dealt principally with chemical tariff problems.

If an effort is made at the conference to prohibit the use of gas in warfare, it is believed it will be prompted by a desire to see the United States stripped of a weapon which she is in a position to use to greater advantage than any other country. The United States has ample supplies of all the raw materials used in chemical warfare. In this she has an advantage over any other country. With proper development in time of peace she would have industries equipped for immediate conversion to gas warfare purposes. In addition to these advantages, the United States is separated from possible powerful enemies by oceans. By the use of gas, our defense could be greatly strengthened. Even with gas in the infancy of its development, it is very generally recognized by military authorities that it makes the landing of troops from overseas so difficult that no attempt would be made to land them directly on our shores.

Another point, frequently lost sight of, is the fact that gas can be limited in its use against non-combatants to the same extent that other weapons of warfare are limited. The most frequently used argument against gas is that non-combatants suffer along with combatants. But we may point out that this applies to all weapons used in the recent war and does not constitute an argument against chemical warfare, since its possibilities of destruction can be confined to certain areas with almost the same exactness as would apply to other weapons. In that connection, however, it may be stated that military authorities do not expect great concern for civilian populations in future wars. The means of warfare have changed to such an extent that discrimination between combatants and non-combatants is growing increasingly difficult.

It is expected that the American delegation will advocate the retention of chemical warfare since the Congress of the United States has approved on several occasions the use of gas in warfare and has set up within the Army the most pretentious chemical warfare service in the world.

The Blight of Finance On Technical Enterprises

THE old-fashioned merchant is passing away. He used to be very much of a person. He ruled his affairs and his employees as well as his junior partners with patriarchal firmness; but he knew his business. He was likely to be a gentleman in what we call the American sense of the word—that is, he was polite in his mind and in his heart, rich in sympathy and gifted with understanding. Often, indeed, he was a man of distinguished culture and a person of taste. He took a reasonable pride in his high station, but still more seriously did he consider and live up to his obligations.

The old-fashioned manufacturer is a later creation, but he, too, is passing. He knew the business end of his industry and he had an understanding of its technology, so far as the old rule-of-thumb methods may be called technology. He also was an important person in the community in which he lived; a little more addicted, perhaps, to whimsical opinions as a substitute for wisdom; but that followed his rule-of-thumb technology, which was not even supposed to be understandable. He was a good citizen and an independent thinker, according to his lights.

These men are passing away, because both commerce and industry are passing over into the hands of bankers. The development of great corporations which have replaced private and personal ownership has placed bankers and lawyers in command. They select directors, chairmen of the boards and presidents. In many industries we find men in control who cannot look or even think beyond the balance sheet. And since accounts are only records of past performances, they cannot see ahead. They are ignorant of the technology of the industries which they direct, and as for the science which underlies the technology they are no better informed than so many hod-carriers. We do not say this of all men in industry, but we do affirm it in relation to so large a number as to threaten our national welfare in industry.

Let's follow out a frequent process: Imagine please, a product greatly needed which is worked out after long and tireless investigation, and the inventor, a scientific man, is associated with a business man who grows in understanding as the venture develops. The demand for the product is so great that they need money for extensions. Their bank of deposit will deal only on their notes, and they want to fund their floating debt and to double or treble their capacity. So they go to the investment banker. At this point the sound

economies which they have always practiced are likely to get a severe jolt. The more money they need the more welcome they are. The broker plans a bond issue, a preferred stock issue and common stock eruption of about the current value per share of German marks. The banker keeps an inordinate share of preferred and common stocks as commissions, but it is a good thing, and the two old boys go on working and planning and directing the corporation's affairs with an unwieldy board of directors, strangers to the business, and hopelessly ignorant. The banker appoints his favorite firm of public accountants to balance the books and with that he feels secure. "The books," he declares cheerfully, "tell the whole story." He can understand the balance sheet; and that is all that he can understand. One director gets his favorite insurance broker appointed, and another places his son-in-law in the office. But the two old boys stick to their jobs and all goes so well that the common stock begins to have value, and we read the quotations in the newspapers. It looks like a good buy.

Then comes the chance for amalgamation, consolidation and a new stock issue. Why not? If grocers buy both flour and sugar, then a consolidation of sugar and flour industries is a proposal of the sort that appeals to the banking eye. It will save duplication of sales force and fill up freight cars to sell more sugar and flour together than of either commodity alone. And in a reorganization there are more commissions which are pleasant to consider. So this particular industry is tied up with something else—"related," as the bankers say—and the consolidation makes it so big that the stockbrokers begin to talk about it. The two old boys cannot see it; they don't know these other lines of business that are coming in; they say they are too old to learn new tricks and so they are bought out because they are not progressive. Then the banker takes hold for fair. He wants a good administrator as president and as likely as not he will get a man who has succeeded in developing a string of 5 and 10 cent stores and will expect him to manufacture this particular product which requires at every step in the process trained, scientific control. "He's got a good business head," says the banker, "and that's what we want here."

True, the new administrator knows the 5 and 10 cent business down to the ground, and the very fact that he has succeeded in it is his worst quality. You can't fool him in the 5 and 10 cent store business but you can put all sorts of foolish notions over on him about this new business, because he does not understand it fundamentally. Little wrong guesses turn out to be thundering mistakes. He is lost in his job because he is befogged with ignorance, and genius itself can't see through a fog. So there is danger ahead. He brings fog and mud instead of a clear vision ahead and a well-thought-out road of progress. Then old Uncle Trouble and Aunt Agony come and settle down as members of the family.

The remedy is easy if it can only be got into the minds of investment bankers. They don't know how to seek information. Their business is that of super-treasurer of the corporations they organize and they do not play the game straight. They do not give value received in honest study and in getting information and in constructive thought in return for what they get out of it. They want the big profits without contributing enough real work. This is their minor fault. Their major fault is that they put the wrong men into ad-

ministration. That is due to their inexcusable ignorance, which they can remedy by study and work. They don't study enough or know enough. If they haven't got the time to learn, or the educational backing to make themselves familiar with the business, they should leave well enough alone—or at least they should learn how to seek advice. It is easy enough to take advice—the difficulty lies in finding out where to get it.

A Notable Movement In Metallurgical Education

A DEFINITE educational movement for the benefit of the "man at the fire" is one of the fundamental aims of the American Society for Steel Treating. Not only is this aim stated in the constitution of the society, but the national officers bear this responsibility in mind. This in turn is doubtless due to a constant urge from the membership, voiced through the officers of the thirty-one local sections, or chapters, so called. All the directors realize that the phenomenal growth of the society has risen from a desire on the part of the skilled heat-treater to acquire some technical and theoretical information on his daily work. This desire must not be disappointed; otherwise the decline of the society will be as rapid as its rise.

A most pretentious effort in educational lines is sponsored by the important chapter at Chicago. Over a year ago they induced the president of Lewis Institute to provide facilities for an evening course in metallurgy, and secured the services of Professor JOHN F. KELLER, of Purdue, to direct the work. Several specialists also volunteered to lecture on certain phases of heat-treatment. This effort proved such a gratifying success that now two separate courses are offered, one on heat-treatment and the other on metallography of iron and steel, each extending over four months, and meeting for three hours two evenings each week.

Such a program is obviously not beyond the resources of many of our technical colleges, and it appears to be one well worthy of imitation. However, other local sections, notably those at New Haven, New York and Bethlehem, did not wait to perfect a working arrangement with some progressive school, but have laid out a well-considered program to occupy the regular monthly meetings; a program which will cover certain branches of the art in a systematic manner, each meeting to be addressed, in not too technical language, by an undoubted authority in his subject. The New Haven chapter demonstrated last year that such a series of meetings was very popular with the members. Knowing that the new president of the society, P. H. GILLIGAN, is a New Haven man, it is unnecessary to remark that his influence will undoubtedly support those members who desire to perform some service for brothers less fortunate in their technical education.

Nor should such meetings be devoid of interest to the skillful metallurgist. One has only to read Professor TYNDALL's fascinating lectures to know that it is possible to instruct both the expert and the layman. Of course, there are few Tyndalls, but now and then the feat so easy for him, so difficult for others, is attained; witness Dr. JOHN A. MATHEWS' masterful address recently given in New York on "What Is Steel?" Commonplace facts stated with precision and interpreted with that discrimination which comes unbidden from many years' experience gives not only instruction to the tyro but a new perspective to the specialist.

Foundations of Trade Unionism

THE very familiar question of which came first, the chicken or the egg, has a sort of parallel in this matter of trade unionism. Is a shop union because the employees are union men, or are the employees union men because the shop is union? Sometimes an employer finds he can't get employees unless he signs the scale and sometimes a man can't get a job unless he has a union card. In branches of the building trades these cards frequently cost \$100 to \$200 apiece. Sometimes, and fortunately more frequently, the shop is "open" and there is no question about unionism. The employer picks out the best men to employ, and a man gets a job if he is good enough.

The question of which is cause rather than effect has been brought prominently before the public by the advertising which the "check-off" in the bituminous coal industry received last week through the granting of an injunction against coal operators using this system. The check-off, instituted a couple of decades or so ago, is a sort of automatic unionism. The scale signed by the operators requires that they deduct from each man's pay his initiation fee, fines and monthly dues and remit in lump sum to the local division of the United Mine Workers. Thus upon accepting employment a man automatically becomes a member of the union, so far as supporting it financially is concerned. If the man is not a good union man, disposed to strike when told, etc., the union can employ to educate him in unionism the funds he helps to provide.

As a system this is very efficient. All that is necessary is to get the scale signed and the rest will usually take care of itself. If there are non-union mines whose competition interferes with the operation of union mines the funds can be employed to unionize those mines, putting them in the same boat with the rest. If when a scale settlement time comes around the men want an increase in wage rates which the operators cannot afford to pay with the existing price of coal, all that is necessary is to fail to agree. Thereupon there is what is called "a cessation of mining" rather than a strike; coal becomes scarce and advances in price, and the operators are then able to pay the advance in wages. The coal operators cannot agree with one another to close their mines in order to improve the market, as that would be a violation of the Sherman law, but there is no law preventing them from disagreeing with the United Mine Workers. It is purely incidental that thereby the union mines all become idle. It is wrong to agree, but all right to disagree, and the public takes (or pays) the consequences.

It is curious, decidedly curious, indeed, that the check-off has existed so long in the bituminous coal industry and in but few other isolated instances. This is no fault of Mr. GOMPERS, for upon the granting of the injunction against the check-off last week Mr. GOMPERS promptly arose to record his protest not merely against Judge ANDERSON'S injunction on union activities in the non-union West Virginia coal field, but against the check-off injunction as well. He "could not see" why a judge interferes with the practice, the decision being "part and parcel of the attempt to repress and subdue labor." Mr. GOMPERS would find his work easier in his declining years if the check-off were made universal. He repeats his threat of the past two years, which the public will heed even less than formerly, that if his

variety of trade unionism is not encouraged the workers will adopt something worse, meaning bolshevism, etc. Mr. GOMPERS ought to have something more interesting to say by this time.

If the bituminous miners will not pay their dues except by having the money taken out of their pay, there is prospect that one of the three great monopolies that have been holding up the American people will have its power lessened. The two others are the railroad unions and the unions in the building trades.

Congress Fears Cupidity In the Chemical Industry

OUR Washington correspondent transmits this week a news item which we commend to all leaders, particularly business leaders, in the chemical industry. We have been preaching in season and out the advisability of continuing research in all our technological industries and the necessity of keeping our chemical industries in the hands of men who appreciate its technical requirements. We have consistently deplored the tendency to curtail research and have pointed out the danger of allowing our great chemical industries to fall into the hands of business men and financiers whose only yardstick is the immediate dollar and with whom success can be reflected only in the balance sheet. If practical evidence were needed to support the wisdom of our contentions, it can be found in the impression prevailing in Congress today "that the banking interests have gained the upper hand in many chemical activities and that there is a tendency to eliminate research and experimentation in the interest of greater profit." In this attitude of mind Congress will scarcely look with favor on claims of the chemical industry for tariff protection. Hitherto the House has been persuaded to recommend unusual measures for the protection of the chemical industry, but favorable consideration cannot be expected if the impression is permitted to persist that men of technical vision are being superseded by business men who look more to immediate profits than to a stabilized industry. We have all gladly joined in the effort to educate Congress to an appreciation of the importance of chemistry in our national welfare, but nobody will rally to the defense of those whose cupidity leads them to exploit a great industry. Steps should be taken immediately to set Congress right in this matter, particularly by those whose actions are responsible for the prevalent impression.

One of the great needs of American chemical industry today is a spirit of unity and solidarity through all the elements that go to make up the whole. It will not prosper if here and there through the ranks are shortsighted individuals in positions of power who consider only their own immediate welfare and make no contribution to the general good. Chemical industry as a whole is going to profit by whatever consideration it gets at the hands of Congress, and it is unfair for a few who are without vision to jeopardize the prospects of success of those who are broad-minded and far-seeing. It may be well to remember that a successful chemical industry requires the attention of chemists. It cannot be fully comprehended by bankers, promoters, stockbrokers, and so-called successful business men, and it is quite evident that Congress has been educated to a point where it realizes this fact, and will look with disfavor upon a chemical industry controlled by such elements.

British Chemical Industry

FROM OUR LONDON CORRESPONDENT

LONDON, Oct. 14, 1921.

THE slow but steady improvement in the chemical trade which developed after the holidays and which, it was expected, would continue after the coming into operation of the safeguarding of industries act has not been maintained, and at the time of writing the demand is not so active. While it cannot be said that markets have received a setback, business is not yet of a stable nature in spite of occasional evidence of considerable and somewhat spasmodic improvement. The prospect of gradual stabilization has been upset by the sudden depreciation of German currency, which has been sufficient almost to neutralize the operation of the safeguarding of industries act in regard to depreciated exchanges, in so far as it affects German imports.

ANOMALIES OF THE KEY INDUSTRIES ACT

The official list of articles chargeable with duty under the key industries act is a formidable document of seventy-three pages, and its importance to the fine chemical industry is demonstrated by the fact that this section covers fifty pages and includes about 2,500 substances, including those protected by the dyestuffs act and marked "D." While it was scarcely to be expected that this act could be operated without serious disorganization and criticism, it is already apparent that the dissatisfaction and inconvenience caused will be more severe than was expected, and not only the technical press but also the daily press is giving prominence to anomalies and complaints mainly in view of the fear of additional unemployment. The principal complaint is that numbers of articles are included which have no real relation to key industries and so give the measure a more broadly fiscal character. In addition, there is the usual unfortunate tendency of customs officials at first to interpret the letter rather than the spirit of the act. Thus importations of toy magic lanterns and eyes in dolls' heads are held up as being optical glassware, the small carbon rods used in pocket batteries are considered to be arc lamp carbons and even electric lamps containing tungsten wire originally supplied by British manufacturers cannot at present be re-imported. A joint conference is to be organized by the London Chamber of Commerce and the Chemical and Dyestuffs Traders Association with the idea of formulating an authoritative case to be laid before the government. Meanwhile the only other activity to be noted is increased advertising by the firms whose products are being protected, often accompanied by announcements of price reductions as an additional bait to the shy purchaser.

LESSONS OF THE OPPAU EXPLOSION

Nothing authoritative has yet been published in regard to the cause of the disaster at the Badische Co.'s works, but discussion of its probable effect on the nitrogen industry and theories as to its origin are rife. It is generally assumed that decomposition or overheating of ammonium nitrate or a mixture of ammonium sulphate and nitrate, either from external causes or through acidity and consequent decomposition, resulted in the ultimate explosion of the products in store and as a result there is some apprehension in regard to stocks of similar commodities at various factories here and on the Continent. There is a close

analogy between this explosion and that of a large quantity of potassium chlorate which occurred at the United Alkali Works near St. Helens in 1899. At that time potassium chlorate had not been known to explode and yet by reproducing the conditions during the fire prior to that explosion it was conclusively shown that when molten and struck a glancing blow with a piece of wood on a brick floor potassium chlorate would explode violently with the utmost regularity. The Claude process for ammonia synthesis continues to make headway and it is rumored that the British group intends ultimately to consolidate its interests by controlling Norwegian production and has in fact already acquired certain water powers from which the cyanamide industry in that country obtains its supply.

GENERAL DESPONDENCY PREVAILS REGARDING THE FUTURE

In spite of the belated legislation, it is freely predicted that the British chemical industry will ultimately revert practically to its pre-war status and importance. An exception is made of the heavy chemical industry, but it is realized that apart from state-supported key industries the chemical industry of Great Britain must in the future as in the past depend largely upon the efforts of the merchants and traders and that these must be placed in a position to maintain to the fullest extent the export and foreign trade, British manufactured goods being necessarily left to find their own level in the face of external competition. In the same way, the future of the chemist is gradually becoming an acute problem, particularly the future of those whose attainments and achievements are below the average or insufficient to warrant their retention in normal work and progress. Probably the junior chemist who lags behind in the race will have to swallow his pride and become a process-foreman or a salesman, and it is not unusual to find men with commercial ability who have become successful travelers, utilizing their technical knowledge somewhat in the way that was practiced by the representatives of German dyestuffs firms before the war. The depression in trade has also militated against the work of unifying chemical and scientific societies, which was initiated by the Federal Council, it being impossible at the moment to attract the funds for a central home. There is still so much jealousy and rivalry among the various societies that none of them can reasonably be expected to show the way without exciting suspicion. Mining engineers have succeeded in getting together and there is still the possibility that through the medium of bodies like the Chemical Industry Club or the Radium (Chemists) Lodge, the foundations can be laid for a better understanding and at any rate for the provision of a common meeting house and library. The lessons learned by the visitors to the United States and Canada are receiving due publicity and it is recognized that the organization of the American Chemical Society excels in its influence not only among chemists but on the American press and public. Meanwhile the Society of Chemical Industry appears to be going through a transition period and many changes are foreshadowed, mainly as regards policy. The crux of the matter is still that of publicity, and in addition members are clamoring for further departures from tradition and the provision of improved meetings and incidentally better entertainment than that which was afforded by the recent annual dinner.

Recent Developments in the Sulphuric-Acid Industry—I

New Methods and Equipment for the Production of Sulphur Dioxide, Precipitation of Flue Dust and Introduction of Nitrogen Oxides in Chamber Process Are Reviewed in the First of an Important Series of Articles

BY ANDREW M. FAIRLIE
Consulting Chemical Engineer

ALL of the important processes for the manufacture of sulphuric acid could formerly be comprised under two general heads: the chamber process, and the contact or catalytic process. The chamber process has itself been considered by some as a kind of catalytic process, but generally it has not been so classified. The distinctive features of the chamber process have been the use of oxides of nitrogen, and of lead chambers, in combination. The recent development of processes which use no chambers, but still use oxides of nitrogen, has upset the former simple classification. These new processes certainly are not chamber processes, nor are they contact processes in the narrower meaning of the term as applied to sulphuric-acid manufacture. A new classification is therefore proposed, and inasmuch as these new processes all use oxides of nitrogen, they are grouped with the chamber process under the general head "nitration processes," leaving the contact processes as they were, in a group by themselves.

This series of articles is based on a lecture delivered by the author before the Franklin Institute of the State of Pennsylvania in the spring of 1921. It is the purpose here, as in the original lecture, to confine attention to nitration processes only, discussing the developments, since 1914, in equipment and appliances, in plant design and construction, and in plant operation. As this discussion is by nature a review, no special claim is made to presenting novelties. Many of the features described herein have appeared in the technical literature and are more or less familiar. Here we concentrate the attention, however, on developments relating to a single industry, and correlate these developments with one another. The descriptions of the devices and inventions considered are brought as nearly as possible up to date, and an opportunity is afforded, with the aid of the illustrations, to contrast or compare them.

RAW MATERIALS FOR SULPHUR DIOXIDE

Prior to 1895 most of the sulphuric acid made in this country was made directly from sulphur, or, as it is commonly called, brimstone. Then during a period of twenty years brimstone was largely supplanted by pyrites. Since 1914, however, the use of sulphur as a raw material for acid making has rapidly increased, and by 1918 the percentage of acid made from sulphur, based on the total acid made in this country, was 48 per cent.

The restrictions on importations of Spanish pyrites during the war, coupled with the extraordinary demand for sulphuric acid for the production of high explosives, gave the brimstone industry an opportunity to regain to a large extent the supremacy, as a raw material for the manufacture of sulphuric acid, which it had enjoyed

TABLE I. QUANTITIES OF SULPHURIC ACID PRODUCED IN THE UNITED STATES FROM DIFFERENT RAW MATERIALS, FOR 1914, 1917 AND 1918

	Tons 50 Deg. Bé. Acid			Per Cent of Total		
	1914	1917	1918	1914	1917	1918
From brimstone.....	100,000*	2,350,000	3,580,000	2.6	32.6	48.0
From pyrite:						
Spanish pyrite.....	1,900,000	1,650,000	570,000	50.0	22.9	7.6
Domestic pyrite, including "coal brasses" and pyrrhotite.....	600,000	850,000	950,000	15.8	11.8	12.7
Canadian pyrite.....	300,000	500,000	550,000	7.9	6.9	7.5
From roasting zinc ores.....	500,000	1,300,000	1,200,000	13.2	18.1	16.1
From waste gases at copper smelters.....	400,000	550,000	600,000	10.5	7.7	8.1
Totals.....	3,800,000	7,200,000	7,450,000	100.0	100.0	100.0

* Approximate.

prior to 1895. Table I shows approximately the extent to which brimstone supplanted pyrites in the manufacture of sulphuric acid during the years 1917 and 1918, as compared with the year 1914.

Since the close of the war Spanish pyrites has again become available, and manufacturers are confronted with the problem, At what price per unit of sulphur contained is pyrites cheaper than brimstone, with the latter at a given price? The answer to this question cannot be found in a comparison of the cost of burning a given weight of sulphur from brimstone with the cost of burning the same weight of sulphur from pyrites. The use of pyrites for the manufacture of acid involves additional costs, as compared with brimstone, beyond the burner room. The costs of removing flue dust, of washing sediment out of tanks, towers and chambers, of acid and niter lost in washing operations and of additional niter required, the increased depreciation of chamber plant, the increase in maintenance expense, the decrease in production capacity of chamber plant, with consequent increase in cost per ton of acid for fixed charges, must all be considered. The answer to the question must be sought, then, in a comparative statement of the cost of a ton of acid made (a) from pyrites, and (b) from brimstone.

BURNER EQUIPMENT

The transition from pyrites to brimstone necessitated a change in burner equipment at many plants. Where burners for lump pyrites had been in use, the change was simple and consisted merely in installing pans in the place of the grate bars. Plants equipped with fines burners installed brimstone burners of one of the well-known mechanical types, such as the Glens Falls horizontal rotary burner, or the Vesuvius, or vertical cylindrical, burner.

¹Compiled from data given by A. E. Wells and D. E. Fogg in "The Manufacture of Sulphuric Acid in the United States," Bull. 184, U. S. Bureau of Mines, pp. 23, 24.

The latter part of 1919 saw the first successful attempt to make sulphuric acid from copper converter gas. This was done at the plant of the Tennessee Copper Co., at Copperhill, Tenn., and followed close upon the heels of a rather remarkable improvement in blast-furnace practice, whereby the quantity of blast-furnace gas lost into the atmosphere was reduced to a very small percentage. The combination of the more complete recovery of the blast-furnace gas with the utilization of the converter gas increased the percentage of sulphur made into acid, based on total sulphur volatilized at the Copperhill plant, from about 70 per cent to upward of 92 per cent. For the past two years the sulphur fume nuisance has practically been eliminated at Copperhill.

Fig. 1 shows the former smoky condition of the plant

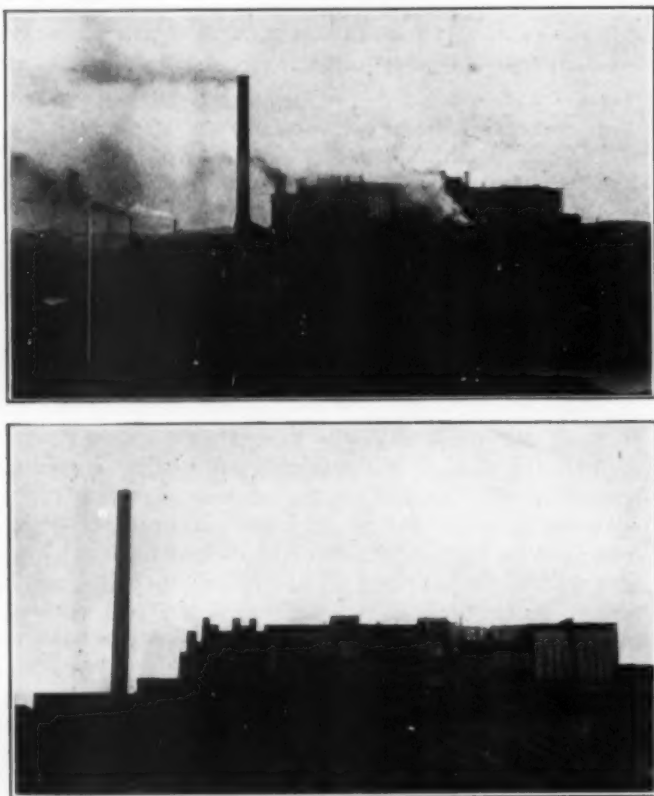


FIG. 1. CHAMBER PLANT OF TENNESSEE COPPER CO., COPPERHILL, TENN., SHOWING CONTRAST BETWEEN FORMER PARTIAL, AND LATER COMPLETE, CONDENSATION OF SULPHUROUS FUMES TO SULPHURIC ACID

of the Tennessee Copper Co. as compared with its present appearance, and clearly indicates the improvement in sulphur recovery efficiency.

The converter gas is blown into the same hot gas flue as the blast-furnace gas, and no attempt is made to keep separate the gases from the two sources. The gases mix in the brick flues, and the introduction of the converter gas has involved no serious complication in operating methods at the acid plants. The successful use of converter gas at Copperhill indicates that sulphuric acid can easily be made from converter gas alone wherever there is a sufficient number of converters in operation to insure an uninterrupted supply of gas.

DUST PRECIPITATION

Flue dust does not concern the acid maker who burns brimstone. Those who burn pyrites, however, or who

make acid as a byproduct of roasting zinc or copper ores or of copper-smelting operations, experience much trouble and expense from the dust coming over with the gas from the burners, roasters or furnaces. At some plants the burner or furnace gas carries, in addition to the dust (fine particles of the furnace or burner charge), metallic fumes, consisting of volatilized metals or metallic compounds, more or less condensed and consisting of very finely divided particles almost as hard to precipitate as the gas itself. The proportion of fume, however, is always small in comparison with the particles of burner or furnace charge, commonly called flue dust, and most acid makers would be content to put up with the fume problem if they could only be rid of the dust.

Various types of mechanical precipitators for flue dust have been briefly described in the recent bulletin by Wells and Fogg.² The same authors have referred to the use of the Cottrell electrical methods for precipitating flue dust from acid-plant gas. In the Cottrell precipitators the gases pass between two electrodes, one of which is grounded, while the other is under a high voltage, 40,000 to 60,000 volts. Two different types of Cottrell dust precipitators have been installed: the pipe treater and the plate treater. In the pipe treater, the grounded electrodes are vertical pipes and the charged electrodes are wires, one of which is suspended vertically in the center of each pipe. The gases may ascend or descend through the pipes, satisfactory distribution of the gas through all the pipes being possible in either case.

In the plate treater the grounded electrodes are parallel plates of steel or sheet iron suspended vertically and arranged parallel to the side walls of the gas flue. Between these plates the charged electrodes are suspended, and the gases either pass horizontally or rise vertically between the parallel iron or steel plates. The first installation of the plate treater had chains for the charged electrodes. More recently narrow strips of steel have been substituted for the chains, and, it is said, have been found more satisfactory. The treaters are designed to electrify the dust or condensed fume particles as the gases pass between the electrodes, so that the electrified dust or fume may be precipitated, chiefly on the grounded electrode. Means for vibrating the electrodes for the removal of accumulated dust may be provided, and the flue is preferably constructed with a hopper-shaped bottom to facilitate the removal of dust. Spare units of Cottrell treaters should always be installed, provided with suitable dampers so that when necessary to clean or repair one unit the gases can be shut off from such unit and passed through the others without interrupting plant operations.

INSTALLATIONS OF ELECTRICAL TREATERS

The initial experiments for the precipitation of dust by the Cottrell process from the hot gases of a sulphuric-acid plant were conducted at the Cleveland plant of the Grasselli Chemical Co. The commercial installations which have been installed include two treaters for the Baugh Chemical Co., Canton Works, Baltimore, Md., two treaters for the General Chemical Co., Delaware Works, and one treater each for the National Zinc Co., Kansas City, Kan., and the Grasselli Chemical Co., Cleveland, Ohio. Some of these treaters are at present not in operation due to burning brimstone in lieu of dust-forming ores. The apparatus used in each case

²Op. cit., pp. 74-75.

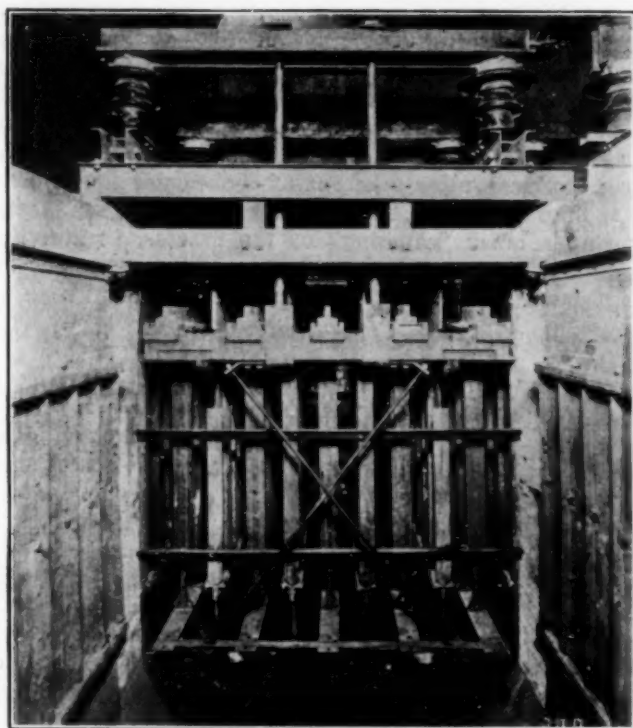


FIG. 2. INTERIOR VIEW OF COTTRELL DUST PRECIPITATOR, PLATE TYPE, FOR CLEANING HOT GASES FROM PYRITES BURNERS

consists of two horizontal chambers in parallel, with dampers in the inlet and outlet gas connections of each.

In the first plate treaters installed for the precipitation of dust from acid-plant gases the plates were too thin and were not ribbed sufficiently to prevent buckling in the hot gas. Trouble was also experienced in the method of supporting the discharge electrodes in the hot gases due to failure of the insulators and steel supporting beams. These difficulties, it is claimed, have been overcome by hanging the discharge electrodes on cast-iron beams and by using heavier plates with more substantial ribbing. These cast-iron beams are in turn suspended on steel tension rods passing through the roof of the flue, from which they are insulated electrically by fused silica bushings. The rods are hung from a steel framework outside the precipitator carried on tapered corrugated porcelain insulators 24 in. high.

EFFICIENCY TEST ON COTTRELL PRECIPITATOR

The right to the electrical precipitation process as applied to cleaning the gases from pyrite burners throughout the United States, with the exception of six of the far Western States, is owned and controlled by the Research Corporation, 25 West 43d St., New York City. Although plate treaters have been installed by this company at one chamber plant operating on pyrites fines, no numerical data on the efficiency of these treaters in precipitating dust are available. Efficiency tests have been made, however, on the improved type of plate treater installed at a contact sulphuric-acid plant in the East, and the data in Table II, obtained from one such test, have been furnished by the courtesy of the Research Corporation.

During this efficiency test the amount of sulphur burned out of the ore per burner per day was 9,350 lb., and as there were six burners the total sulphur burned was 56,100 lb. per day, equivalent, at 95 per cent sulphur recovery, to about 210,000 lb. of 60 deg Bé. acid. Since

TABLE II. RESULTS OF EFFICIENCY TEST ON COTTRELL DUST TREATER, PLATE TYPE

Dust and Elements in the Dust	Pounds Precipitated	Percentage Precipitated	Pounds Not Precipitated	Percentage Not Precipitated
Dust.....	1,700.00	98.94	18.25	1.06
Soluble iron.....	14.45	83.24	2.95	16.76
Arsenic.....	70.00	24.21	218.00*	75.79
Lead.....	262.00	81.59	59.00*	18.41

The partial analysis of the precipitated dust was as follows:

	Per Cent
Sulphur.....	4.17
Soluble iron.....	0.85
Lead.....	15.40
Arsenic.....	4.11
Acidity.....	5.98

Total..... 30.51
The remainder of about 70 per cent was assumed to be chiefly oxides of iron.

* This weight is evidently considered to be present in the hot gas as volatilized metallic fume, not as dust.

18.25 lb. of dust, 2.95 lb. of soluble iron, 218 lb. of arsenic and 59 lb. of lead escaped precipitation by the Cottrell apparatus, those amounts of impurities would be contained in the 210,000 lb. of 60 deg. acid, if chamber acid had been made from the gas, instead of contact acid. The percentage of impurities in the 210,000 lb. of acid would then have been:

	Per Cent
Dust ³	0.0087
Soluble iron ⁴	0.0014
Arsenic ⁴	0.1037
Lead ⁴	0.0284

It is interesting to note that the arsenic was the least efficiently precipitated, due, no doubt, to the fact that it was present in the gas chiefly as uncondensed fume, and not as dust.

The cost of such a Cottrell installation for cleaning the hot gases from pyrites burners capable of burning 30 tons of sulphur per day is given by the Research Corporation as about \$60,000. The gas volume produced by the burning of the tonnage of sulphur stated would be about 20,000 cu.ft. of gas per minute, at 1,000 deg. F. The operating cost is small. Power consumption would be 1.5 kw. for the entire installation, and the only operating labor required would be an occasional inspection by the plant electrician, and labor once a week to remove the dust from the treater.

The Research Corporation states that a 90-day test on such an installation, while treating a volume of gas of from 17,000 to 22,000 cu.ft. per minute at a temperature of from 800-1,000 deg. F., with a temperature drop through the installation of about 100-125 deg. F., has shown a dust removal of 99 per cent continuously. Fig. 2 shows the interior of a Cottrell precipitator for cleaning hot gases from pyrites burners, and Fig. 3 is a photograph of the electrical equipment employed.

SCREEN TYPE OF ELECTRICAL TREATERS

A modification of the Cottrell treater for the precipitation of dust from hot gases has been developed by R. B. Rathbun, of the American Smelting & Refining Co. The main feature of this modification, on which patents are pending, is the use of sheets of iron screen, with diamond-shaped or square meshes about 2 in. wide, placed transverse to the direction of flow of the gases, and parallel to each other, with an intervening space of about 6 in. between adjacent screens, instead of the

³Total solids in the gas at the temperature at which the gas was cleaned.

⁴Probably present as a vapor at the temperature at which the gas was cleaned.

iron plates of the treater advocated by the Research Corporation. In some instances the wire screen has been replaced by expanded metal having diamond-shaped meshes of the desired width. Midway between the sheets of screen, or of expanded metal, as the case may be, wires are suspended vertically—about 6 in. apart across the width of the flue, with alternate rows of wires staggered. The screens are the grounded electrodes, and the wires the charged electrodes. This type of treater may be called the "screen treater," to distinguish it from the Cottrell treaters of the Research Corporation. High voltage is used, as with the Cottrell treaters.

The screen treater offers the apparent advantages over the Cottrell plate treaters, (a) that the grounded electrodes are placed transverse to the direction of gas

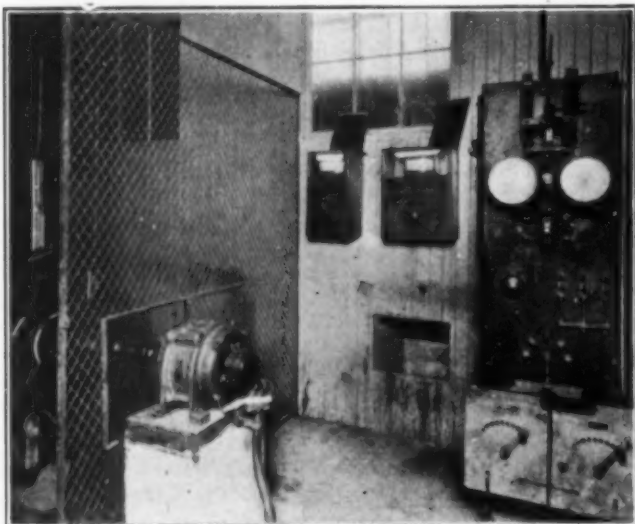


FIG. 3. ELECTRICAL EQUIPMENT FOR USE WITH COTTRELL ELECTRICAL PRECIPITATION PROCESSES

flow instead of parallel thereto; and (b) that the screens themselves, without any electrical equipment, are of a form adapted for the precipitation of dust. From time to time the screens and wires are jarred to shake off adhering dust, and during the operation of jarring or tapping, the gases are diverted into another flue. In some cases the efficiency of the screen treater seems to have been improved by injecting a finely divided spray of sulphuric acid, at intervals, into the gas stream, and this spray lodges temporarily on the screens and wires. The screen treater is said to be in successful use at some of the plants of the American Smelting & Refining Co. for the precipitation of dust from the gases of lead-smelting furnaces, where the temperature of the gas is in the neighborhood of 400 deg. F.

The burner or furnace gases of an acid plant are, of course, much hotter than this, and the results of the application of the screen treater to gases of a temperature of 800-1,000 deg. F. will be awaited with interest.

After leaving the dust chamber, or the electrical treater, as the case may be, the hot gases pass first to the niter potting equipment, if any, and then into the Glover tower.

NITRATION EQUIPMENT

On account of the inconvenience caused by the accumulation of niter cake in the hot gas flues, there has been a tendency of late, where niter pots are used, to install these outside of the flues, and fire them with

coal. In some cases, where the gases are not hot enough to "cook" the niter efficiently, outside pots are a necessity, if pots are used at all. The coal expense has been found to amount to from 1c. to 4c. per ton of 60 deg. acid produced, and this expense is less than the losses incurred in shutting down the entire plant in order to clean niter cake out of choked gas flues. The coal fired pots have, too, proved very efficient in facilitating a quick "catching" of the process, in starting a new plant, or in starting up after a temporary shut-down.

SPRAYING NITER SOLUTION INTO CHAMBER

At some plants nitration is effected by spraying a solution of nitrate of soda through atomizing nozzles located in the lead top of the front chamber. The strength of solution used is different at different plants, but at any one plant it should not vary appreciably. Some plants use solutions as low as 13 deg. Bé., others as high as 25 deg. Bé. A solution which is too weak may result in low drips and weak acid in the front chamber, while too strong solutions may not afford sufficient flexibility in controlling the supply of niter to the best advantage. The admission of nitrate solution into the front chamber results in the formation of sulphate of soda in the acid, and in many cases this is objectionable. Failure to maintain close inspection of the atomizing efficiency of the spraying nozzles may result in streams of liquid solution falling into the acid in the pan of the front chamber, with subsequent formation of liquid nitric acid, followed by undue corrosion of the bottom lead of the chamber. Where the acid is allowed to flow from the front chamber to other chambers, this corrosion may spread throughout the entire plant.

At times when it is desired to operate the chambers at a capacity much below normal, the temperature of the front chamber may be too low to vaporize the atomized niter solution, and liquid solution may fall to the bottom of the chamber. At such times, too, the burner gases may not be hot enough to cook properly the niter in pots located inside the hot gas flue; and in such cases the outside coal-fired pots are very desirable. Spraying niter solution into the front chamber has the advantage that it is a labor-saving device. Under certain conditions it is a more desirable method of nitration than potting. Other means of nitration, such as feeding nitric acid or nitrosulphuric acid into the Glover tower, are well known.

NITRATION BY OXIDIZED AMMONIA GAS

During the war a development of the attempts to use atmospheric nitrogen for the manufacture of nitric acid, either by the cyanamide process or by modifications of the Haber process, was a successful catalytic method of oxidizing ammonia gas to oxides of nitrogen, by passing the former through incandescent platinum gauze. In the early stages of the development of this method the platinum catalyzer was electrically heated; later this external heat was found to be unnecessary. This catalytic method of oxidizing ammonia gas has been fully described by Parsons¹ and by Perley.²

Information received by the author indicates that equipment for oxidizing ammonia gas has been installed

¹Charles L. Parsons, "Commercial Oxidation of Ammonia to Nitric Acid," *J. Ind. Eng. Chem.*, vol. 11, p. 541 (June, 1919).

²George A. Perley, "The Commercial Oxidation of Ammonia," *J. Ind. Eng. Chem.*, vol. 12, p. 5 (January, 1920); and p. 119 (February, 1920).

at several sulphuric-acid plants in England and at one plant at least in the United States, and that the nitration of the chamber process has been effected by this means. The installation in the United States referred to was at the plant of the Ammo-Phos Corporation, a subsidiary of the American Cyanamide Co., at Warners, N. J. This equipment was installed in 1916, and has been referred to by Pranke,¹ who gives a tabulated statement as to the efficiency of the electrically-heated catalyzers.² No data are available as to the actual cost of operating this equipment, as compared with operating the usual sulphuric-acid plant niter-potting equipment, and even if such data were available, it would have to be taken into account that this particular installation was at the plant of a company which is itself a manufacturer of the raw material, and others who would have to purchase the ammonia might find themselves in a less favorable position.

The catalyzers developed by the Government at Nitrate Plant No. 1, Sheffield, Ala., dispensed with the equipment for electrically heating the platinum gauze, and it is claimed that the oxidizing efficiency of the improved catalyzers has been brought up to 95 per cent and higher. Costs for operating labor are very much less with the ammonia oxidation equipment than with niter-potting equipment. Over a period of 22 years, according to The Barrett Co., of New York City, nitrogen as ammonia has cost slightly more per unit than nitrogen as nitrate of soda; but if ammonia can be bought on a sliding scale on an approximate parity with prevailing prices for nitrogen as nitrate of soda, the cost of the raw material should not be an important factor.

FACTORS TO BE CONSIDERED IN SUBSTITUTING AMMONIA OXIDATION FOR NITER POTTING

For those acid manufacturers who are contemplating a change from niter potting to ammonia oxidation, some of the important features to consider are:

1. First cost of plant, as compared with cost of niter-potting equipment.
2. Comparative costs of maintenance of plant.
3. Comparative rate of depreciation of plant.
4. Relative cost of raw materials per unit of nitrogen contained.
5. Comparative efficiency, in producing oxides of nitrogen, of ammonia oxidation apparatus versus niter pots.
6. Comparative cost of operating labor.
7. Comparison of freedom from interruptions, in service, of the two types of equipment.
8. Ability to obtain an adequate and unfailing supply of ammonia, delivered in the quantities and at the times required, to insure uninterrupted operation of the ammonia oxidation apparatus after having once installed it. (The maintenance of a niter-potting equipment as a reserve should not be considered.)
9. Probability of wastage of liquid ammonia and of ammonia gas, through leaks and spills, as compared with wastage of nitrate of soda.
10. Actual arrangements, ascertained by inquiry of the ammonia dealers, which it is possible to make in this country for the purchase of ammonia, either as sulphate or as liquor, over a period of years.

Atlanta, Ga.

(Part II will be published in a subsequent issue.)

¹E. J. Pranke, "Development in Nitric-Acid Manufacture in the United States Since 1914," *CHEM. & MET. ENG.*, vol. 19, p. 395 (Sept. 25, 1918).

²See American Fertilizer Hand Book, 1920, p. D-3.

Corrosion Protective Action of Certain Colloidal Solutions

BY WILBERT J. HUFF*

IN CONNECTION with an investigation concerning the causes and prevention of after-corrosion in the bores of firearms, information was obtained upon corrosion beneath oil films. It appeared advisable to supplement this information with additional experiments and to present the whole.

Oils of many types are universally employed for the temporary protection of bright iron and steel surfaces and have, in general, proved adequate. Nevertheless, repeated examples have shown that ordinary oil coatings may fail almost completely. The circumstances surrounding such failures are generally interesting and sometimes puzzling. The writer recently received the complaint that the physical condition of the workman appeared to influence the protective action of petrolatum, for polished steel surfaces packed beneath a coating of this by one workman corroded more frequently than similar surfaces packed by another. The corrosion sometimes traced finger prints. Rifle parts handled by persons afflicted with gout are said to corrode in spite of careful cleaning and oiling.

MECHANISM OF CORROSION UNDER OIL FILMS

In a paper¹ already published the writer has shown that ordinary oils alone possess no value for the protection of the bores of firearms against after-corrosion following use. Oil films are permeable to water vapor and their anti-corrosive action rests upon the preferential wetting of the metal by the liquid oil which thus interposes a non-conducting film between liquid water and the metal. In the absence of contact between the liquid water and the metal, corrosion cannot occur. The discharge of the firearm deposits a water-soluble compound (potassium chloride) over the bore surface. Exposed to a rather high humidity, this compound deliquesces beneath ordinary oil and so forms a corrosive aqueous film in direct contact with the metal.

This mechanism applies to many cases of corrosion beneath oil films. A water-soluble salt (sodium chloride) is an important part of perspiration residues, hence the finger prints. The excretion of perspiration is dependent upon physiological conditions which vary to some extent from worker to worker, hence the personality factor.

Corrosion under oil caused by corrosive water-soluble compounds presents very important problems. A vast number of manufacturing, assembling and packing operations involve handling, with the concomitant danger of salty perspiration residues. Moreover, similar forms of corrosion may be expected where iron or steel surfaces are exposed to finely divided salts carried mechanically through the air (a common condition near the ocean and in the presence of certain manufacturing operations) or where such surfaces are exposed to certain volatile water-soluble compounds.

A second serious menace presented by such water-soluble compounds is their ability to form corrosive

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*Research chemist, Pittsburgh Experiment Station, Bureau of Mines.

¹Huff, W. J., "The Cause and Prevention of After-Corrosion on the Bore Surfaces of Firearms," *J. Ind. Eng. Chem.*, September, 1920, vol. 12, p. 862.

liquid films at humidities which may be much below that humidity at which clean iron and steel corrode.¹

Were all the surfaces upon which the water-soluble compound is deposited accessible, the prevention of such corrosion would be a relatively simple matter. Such surfaces can be given a thorough preliminary washing with water, followed by wiping. They may then be oiled with safety. Drying by evaporation following the use of tap water is not to be recommended, since such water contains salts which would thus be deposited upon the metal surfaces. Unfortunately, the bright surfaces of many assembled parts are so inaccessible that it is impossible to wipe them dry.

Experiments given below show that the water may be absorbed into a suitable emulsion. Such emulsions are almost ideal agents, for they are non-corrosive and may be readily forced over very inaccessible surfaces.

Six plates 2.5 x 3 x 0.2 cm. were cut from the same piece of steel and machined to a uniform surface. They were all carefully washed with soap and water, a hot 10 per cent solution of sodium carbonate, distilled water, alcohol and finally ether, in the order given. They

TABLE I. ANTI-CORROSIVE ACTION OF CERTAIN EMULSIONS WHEN AN EXCESS OF THE EMULSION IS IN CONTACT WITH THE STEEL

Plate No.	Medium	Change in Weight	
		First Exposure Two Days	Second Exposure Five Days
1	Ammonium oleate plus water	Gain 0.5 mg.	No change
2	Ammonium oleate plus water	Loss 0.1 mg.	Loss 0.1 mg.
3	Water-oil emulsion	Gain 0.1 mg.	Loss 0.3 mg.
4	Water-oil emulsion	Gain 0.2 mg.	No change
5	Distilled water	Loss 12.5 mg.	Loss 28.3 mg.
6	Distilled water	Loss 12.5 mg.	Loss 27.1 mg.

were then carefully weighed. Two were suspended in distilled water, two in an emulsion of ammonium oleate two parts and water one hundred parts, and two in an emulsion of one volume of the above ammonium oleate solution with one volume of neutral transformer oil (sp.gr. 0.855 at 15.5 deg. C.). The depth of immersion and the access of light and of air were identical in all three systems.

Throughout both exposures, plates 1, 2, 3 and 4 maintained their initial polish. Table I shows that bright steel surfaces may be left in contact with an excess of either emulsion safely for many days. After the second exposure all six plates were immersed in their respective solutions for an hour, then exposed to a laboratory atmosphere for twenty-seven days. At the end of that time all adhering material was removed and the change in weight determined.

The loss of weight of plates 1 and 2 was due to the formation of iron oleate, which was readily loosened, leaving the luster of the surface somewhat dimmed. The slight loss of weight of plates 3 and 4 was due to the formation of a trace of iron oleate. Under the conditions of Table II the emulsion containing oil is much to be preferred to the ammonium oleate-water emulsion. This may be due to the lower concentration of free oleic acid in the adhering film.

A comparison of the results shown in Tables I and II for plates 1, 2, 3 and 4 shows that a large amount of water may, under some conditions, aid in preventing attack. The chief loss in the conditions of Table I to give these of Table II is water, since the soap, oleic acid and oil are only slightly, if at all, volatile, and it will be shown below that the possible loss of free ammonia in itself is probably not of much consequence.

The anti-corrosive properties of ammonium soap solution shown above are apparently not unusual, for sodium

and potassium soaps in distilled water likewise prevent corrosion. This is true even in the presence of an excess of oleic acid. It is possible that other emulsions superior to the ammonium soap solutions studied could be prepared by the aid of other soaps.

Although not specially investigated, observations indicated that these soap solutions and emulsions hold their anti-corrosive properties in the presence of low concentrations of corrosive salts. However, it is not safe to allow the concentration of such salts to rise while the mixture is in contact with iron and steel surfaces, for by evaporation, concentrations can be reached at which corrosion results. Thus a piece of steel immersed in a solution of potassium chloride (1 per cent) containing a sodium soap (about 2 per cent), then exposed to evaporation, gave characteristic pitting rust so often noted in salt corrosion. A second piece immersed in a solution of the same soap (about 2 per cent) in distilled water, then exposed to evaporation, remained perfectly bright under analogous conditions.

The protective action of the soap solutions and emulsions can hardly be due to their alkalinity, for the ammonium soap solution used in the above experiments retained its anti-corrosive properties after air had been blown through it for several days to drive out any ammonia which might have been formed by hydrolysis. A better explanation suggests the preferential coating of the metal surface by the colloid or oil, resulting in the formation of a non-conducting film. This preferential coating action probably explains the anti-corrosive action of oils to which certain peptizing agents

TABLE II. ACTION OF CERTAIN EMULSION RESIDUES WHEN ALLOWED TO EVAPORATE IN CONTACT WITH STEEL

Plate No.	Medium With Which the Plate Was Initially Coated	Change in Weight
1	Ammonium oleate, plus water.....	Loss 2.8 mg.
2	Ammonium oleate plus water.....	Loss 2.5 mg.
3	Oil-water emulsion.....	Loss 0.3 mg.
4	Oil-water emulsion.....	Loss 0.4 mg.
5	Distilled water.....	Gain 0.1 mg.
6	Distilled water.....	Gain 0.5 mg.

have been added. Exposed to the atmosphere, under certain conditions, such a mixture takes up sufficient water to form an emulsion, the aqueous phase of which dissolves the corrosive compound. The use of such oil-peptizing mixture is not, however, entirely satisfactory, since the supply of compound may be relatively large or the rate of supply of moisture from the atmosphere relatively small, thus permitting the formation of a concentrated electrolyte which may not emulsify readily, but may instead remain in contact with the metal at some point and so cause corrosion. A somewhat more satisfactory expedient is to use an emulsion containing considerable water, thus insuring a low concentration of salt in the aqueous phase. Here, again, the expedient is not ideal, for the vapor pressure of the aqueous phase may endanger a portion of the metal not protected by actual contact with the oil or colloid. Moreover, a low atmospheric humidity may so concentrate the emulsion that this may break and deposit a corrosive residue in contact with the metal.

At present it is believed that thorough washing with water, followed immediately by a careful rinsing with a suitable emulsion and lastly by a coating of oil, is the best treatment available for the temporary protection of inaccessible bright steel surfaces.

Chemical Research Laboratory,
Pittsburgh Experiment Station,
Bureau of Mines.

Nitrogen in Carburized Steels

Nitrogen Plays a More Important Role in Everyday Metallurgy Than Is Generally Supposed—Many Commercial Carburizers Introduce Considerable Amounts of This Element—Micrographic Methods for the Detection of Nitrogen Compounds Worked Out and Described

BY W. E. RUDER AND G. R. BROPHY
Research Laboratory, General Electric Co.

THE presence of nitrogen in steel under certain conditions has been recognized for forty years, although little attention was paid to its effect until 1905, when Braune and later Strauss studied its effect in quantities greater than those ordinarily found in commercial practice.¹ Since the revival of interest in the effect of nitrogen, due to the study of its marked influence upon the ductility of electric arc welds, its presence in at least two other important conditions has been suggested. Lieutenant Wheeler² and Knight³ have advanced a most plausible theory that nitrogen is the active agent in the hardening and erosion of gun liners. Brophy and Leiter⁴ demonstrated that case-hardening by the cyanide process is largely a nitroge-nizing rather than a carburizing process.

The work reported in this paper is a continuation of this latter investigation and deals with the introduction of nitrogen by solid carburizers such as are largely used commercially, and the effect of various elements often found in alloy steels.

ETCHING FOR NITROGEN

The presence of nitrogen may frequently be detected by the nitride needles which are quite characteristic,⁵

¹Comstock and Ruder, "The Effect of Nitrogen on Steel," *CHEM. & MET. ENG.*, vol. 22, p. 399 (1920).

²Wheeler, "Nitrogen in Steel and the Erosion of Guns," *Mining and Metallurgy*, No. 160, April, 1920.

³Knight and Northrup, "Notes on the Effect of Nitrogen on Steel," *CHEM. & MET. ENG.*, vol. 23, p. 1107 (1920).

⁴Trans., Am. Soc. Steel Treaters, March, 1921, *CHEM. & MET. ENG.*, vol. 23, p. 968.

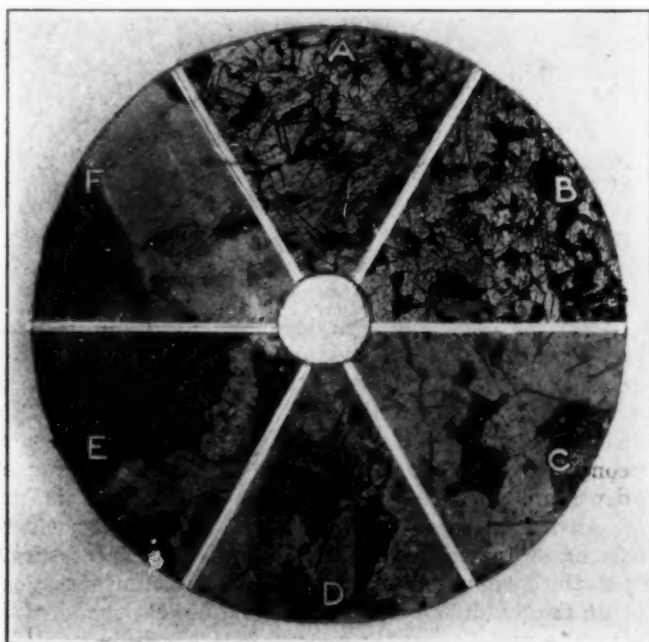


FIG. 1. PURE IRON AFTER HEATING WITH SIX COMMERCIAL CARBURIZERS. ETCHED WITH HNO_3

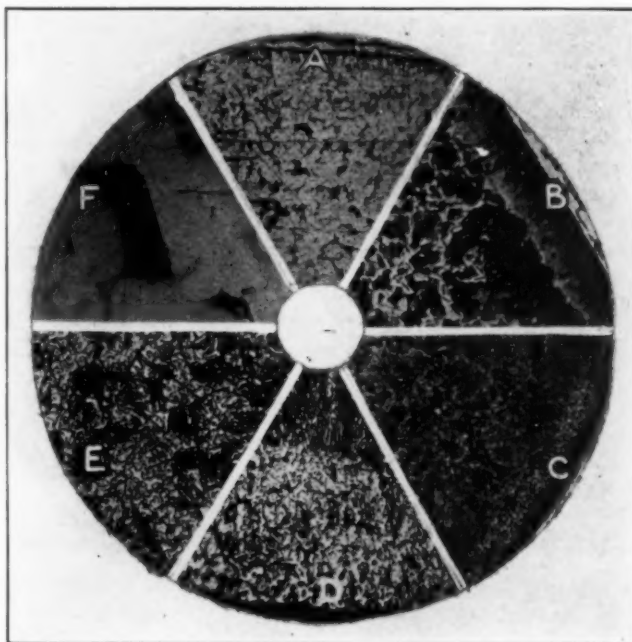


FIG. 2. EFFECT OF HEATING CARBON STEELS IN CHARRED LEATHER

A and F, electrolytic iron at 100 and 400 dia. respectively.
B and E, 0.50 C steel at 100 and 400 dia. respectively.
C and D, 0.90 C steel at 100 and 400 dia. respectively.

but when it is present as a solid solution in the ferrite or as a eutectoid (possibly between FeN and Fe) its presence may easily be overlooked. In the latter form it resembles an imperfect form of pearlite.

Heat-tinting gives a clue to its presence when dissolved in the ferrite, as ferrite grains containing dissolved nitride color much more rapidly than pure ferrite.

In order to distinguish between nitrogen patches and pearlite a $\text{CuCl}_2 + \text{HCl}$ reagent was developed which has given excellent results. This has already been briefly described⁶. The sample is polished in the usual manner, after which it is washed and dried carefully with a soft cloth. Stead's (phosphorus) reagent has been found to have about the right proportions of Cu and HCl and since it is one usually found in all metallographic laboratories is recommended for use. The proportions are 2.5 g. CuCl_2 , 10 g. MgCl_2 , 6.25 c.c. HCl and 250 c.c. $\text{C}_2\text{H}_5\text{OH}$. Just enough hot water is used to dissolve the MgCl_2 and CuCl_2 . The surface of the sample is covered with the reagent, and as soon as a copper deposit shows on the surface the sample is washed, dipped into hot water and dried with a single blast of compressed air. The washing and drying must be performed rapidly or there is danger of discolora-

⁶*CHEM. & MET. ENG.*, vol. 22, p. 403 (1920). Wheeler, "Nitrogen in Steel," discussion by W. E. Ruder, *Mining and Metallurgy*, April, 1920.

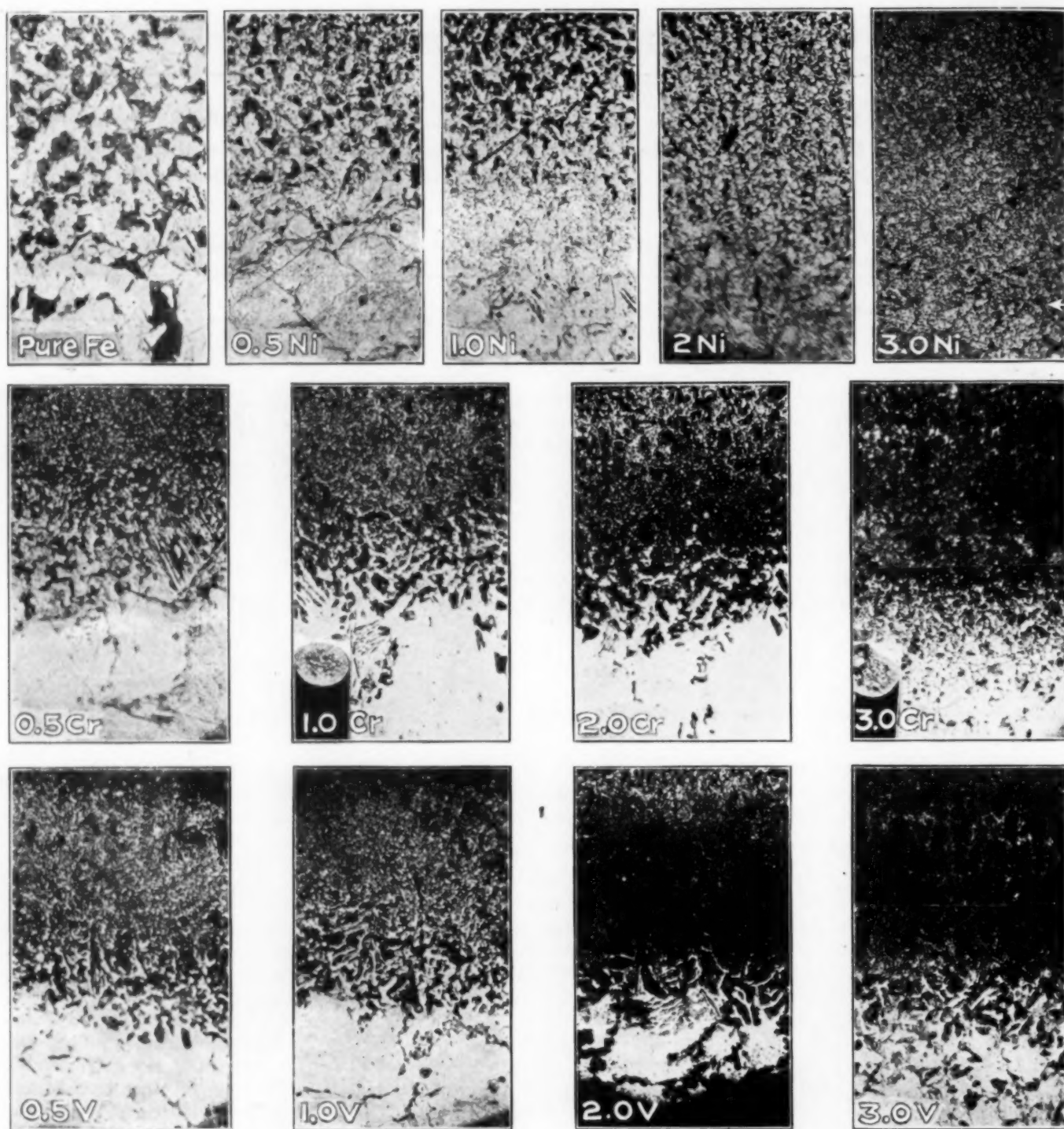


FIG. 3. MICROSTRUCTURE OF CYANIDED ALLOY STEELS. ETCHED WITH HNO_3 . $\times 200$

tion, leading to erroneous conclusions. The etching solution must not be permitted to dry on the surface—more solution should be added if the deposit is slow in forming.

When properly etched the ferrite is covered with copper, the cementite remains bright and the pearlite is also white. The nitride needles and the white (nitride?) hard constituent of the eutectoid patch are black. On further etching the pearlite also becomes copper plated, but the cementite remains white and the nitride etches out and, in appearance, remains dark. If the sample has been previously etched with nitric or picric acid, it should be repolished before applying this reagent.

Comstock⁶ finds that the use of an additional reagent aids in making the distinction more certain. He suggests boiling the specimen for 10 to 30 minutes in a reagent, 10 g. KOH and 1 to 4 g. $\text{K}_2\text{Fe}(\text{CN})_6$, dissolved in 100 c.c. of water. With this treatment cementite is blackened, pearlite and sorbite are turned brown and the "massive" nitride constituent is unchanged or at most slightly stained. In our experience this latter treatment has rarely been found necessary.

It is to be noted that this use of a cupric reagent is distinctly different from other applications of this versatile metallographic reagent. It has been used for

⁶Discussion, "Nitrogen in Steel," *Mining and Metallurgy*, No. 160, April, 1920.

the detection of phosphorus, nickel, cobalt, tin, antimony, silicon, carbon and oxygen when present in solid solution.⁷ In such cases it owes its value to the fact that solid solutions of these elements in iron are electro-positive to pure iron and remain white while copper is deposited on pure ferrite. In the case of the nitrogen compounds the action is more positive, as they are actually attacked by the reagent and blackened. Heat-tinting colors nitrogen areas first, in this resembling the action of other elements such as phosphorus. Oxygen existing in solid solution or around the grain boundaries is also distinguished from nitrogen, which often exists in the same position, by the fact that oxygen areas remain white, while nitrogen areas turn dark.

NITROGEN INTRODUCED BY CASE-HARDENING

Many case-hardening operations, especially cyaniding, introduce varying amounts of nitrogen. It has been shown that the hardness was largely due to nitrogen and not alone to the 0.30 per cent C introduced, which is not sufficient to cause the hardness found. The action of N_2 , as far as our experiments have gone, is very much like that of carbon, and the resulting structures are very much alike. The copper reagent makes a clear distinction, but does not photograph well. However, after some experience nital etching is sufficiently good, as the forms of patches and needles are characteristic. The patch and needle structure are formed best after annealing.

Case-hardening appears to consist of two distinct elements: (1) Nitrogenizing—the most important hardening element in cyaniding, whether the molten, gas or cyanamide process is used—and (2) carburizing—when solid or gaseous carburizer are used which do not contain too much of the nitrogen-bearing “energizers.”

COMMERCIAL CARBURIZERS

Nitrogenous materials are very often added to commercial carburizers on the assumption that they aid in the penetration of the carbon. We know now, however, that this is not the case. The effect is one of additional hardness, due to combined nitrogen. This nitrogen penetrates deep into the specimen, and nitrogen needles are found inside the case proper. The brittle-

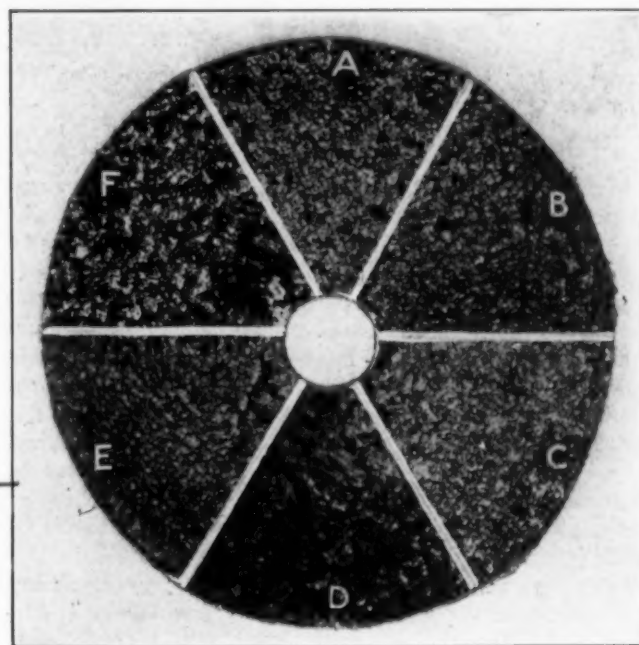


FIG. 5. MICROSTRUCTURE OF COMMERCIAL STEELS AFTER CYANIDING. ETCHED WITH HNO_3 . $\times 200$

- A, 1.5 per cent Ni steel.
- B, 3.5 per cent Ni steel.
- C, 0.5 per cent Cr steel.
- D, 1.0 per cent Cr steel.
- E, 0.25 per cent V steel.
- F, 0.50 per cent V steel.

ness caused by this nitrogen may well be the cause of numerous and perplexing cases of exfoliation.

Through the courtesy of several well-known manufacturers of carburizing compounds, samples were obtained and carbonless iron rods were carburized in them. Resulting structures are shown in Fig. 1. Each section represents a different brand of carburizer. A and B are very high in N, being obtained with green bone and leather, respectively; C and D have small amounts of N and E and F are entirely free of N. All of these micrographs are of spots in the “needle zone” of the case which is at the boundary between case and core. A and B, at 200 diameters, are practically pure nitrogen cases obtained with green bone and leather, respectively. In C and D, at 500 diameters, attention is called to the “angular” shape of the pearlite; it is also not well laminated. These points, particularly the former, are characteristic of pearlite which

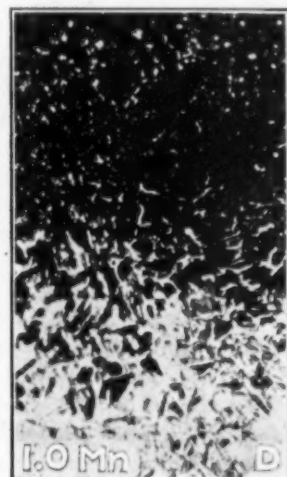
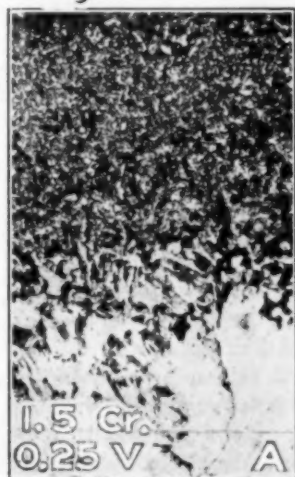


FIG. 4.

A and B, microstructure of cyanided Cr-V steels. $\times 200$. C and D, microstructure of cyanided manganese steels. $\times 200$.

⁷Stead, *Engineer*, vol. 111, p. 627 (1921).

contains nitrogen. The needles in the ferrite are unmistakable. *C* to *F* are of higher power (500 diameters) than *A* and *B*, to bring out the structure of the pearlite.

DETECTION OF NITROGEN IN CARBON STEELS

Small amounts of nitrogen in the presence of considerable carbon are difficult to detect micrographically. Its effect upon the structure and form of the pearlite is, however, quite marked. (See Figs. 2*E* and 6.)

A series of steels were packed in the same container in charred leather and heated to 900 deg. C. for 3 hours and cooled slowly. As has been shown, heating in charred leather introduces a large quantity of nitrogen as well as carbon in the steel. Fig. 2*A* is of carbonless, hydrogen fused, electrolytic iron, swaged to $\frac{1}{4}$ in. rod, copper plated to prevent carbon penetration and treated as above. The dark patches are nitride patches, numerous needles occurring between. The structure of the patch is shown in detail in micrograph 2*F*. There is a certain resemblance to pearlite; but the dark areas are not truly laminated and are more angular and surrounded by the characteristic hard, white border. It is interesting to note here that copper-plating prevents the penetration of carbon, but not of nitrogen. This may account for the fact that copper-plating often fails to prevent hardening of the steel. If no nitrogen is present in the carburizer used, the copper will prevent any hardening.

Micrograph 2*B* shows a 0.50 C steel treated as above except with no copper-plate.

Numerous needles appear between the grains of pearlite for about $\frac{1}{8}$ in. in from the surface. On the surface is a light-colored constituent which looks like decarbonized metal, but decarbonization under these conditions is not likely to occur. Micrograph 2*E* shows a higher power of this border. The pearlite has lost its laminated structure and a hard, white constituent like "massive" cementite and numerous needles are found.

Fig 2*C* shows a 0.90 C steel after treatment. The border is not as wide as in the 0.50 C steel, and no needles appear among the pearlite grains. 2*D* is a higher power of this border. It has more of the hard, white constituent and hardly any pearlite or nitrite patches.

It appears, therefore, that as the percentage of carbon increases the penetration of nitrogen decreases and that the nitrogen tends to hold the carbon in solution, forming a hard, white constituent resembling cementite. This confirms the experiments of Andrew,* who found that N suppressed and lowered the Ar₁ point and of Wheeler,* who found that white cast iron showed no penetration of N when heated in ammonia. There is, therefore, great danger from brittleness involved in the use of nitrogen-bearing carburizers for treating medium and high carbon steels.

ACTION OF NITROGEN ON NICKEL STEELS

Carbonless iron alloys were prepared containing various amounts of nickel. These were swaged to $\frac{1}{4}$ -in. rods, and cyanided for 3 hours at 800 deg. C. to study the effect of nickel on the penetration and metallographic appearance of nitrogen. (Fig. 3.) In the case of an alloy containing 0.5 per cent Ni the penetration is deep (0.060 in.), the Ni having offered prac-

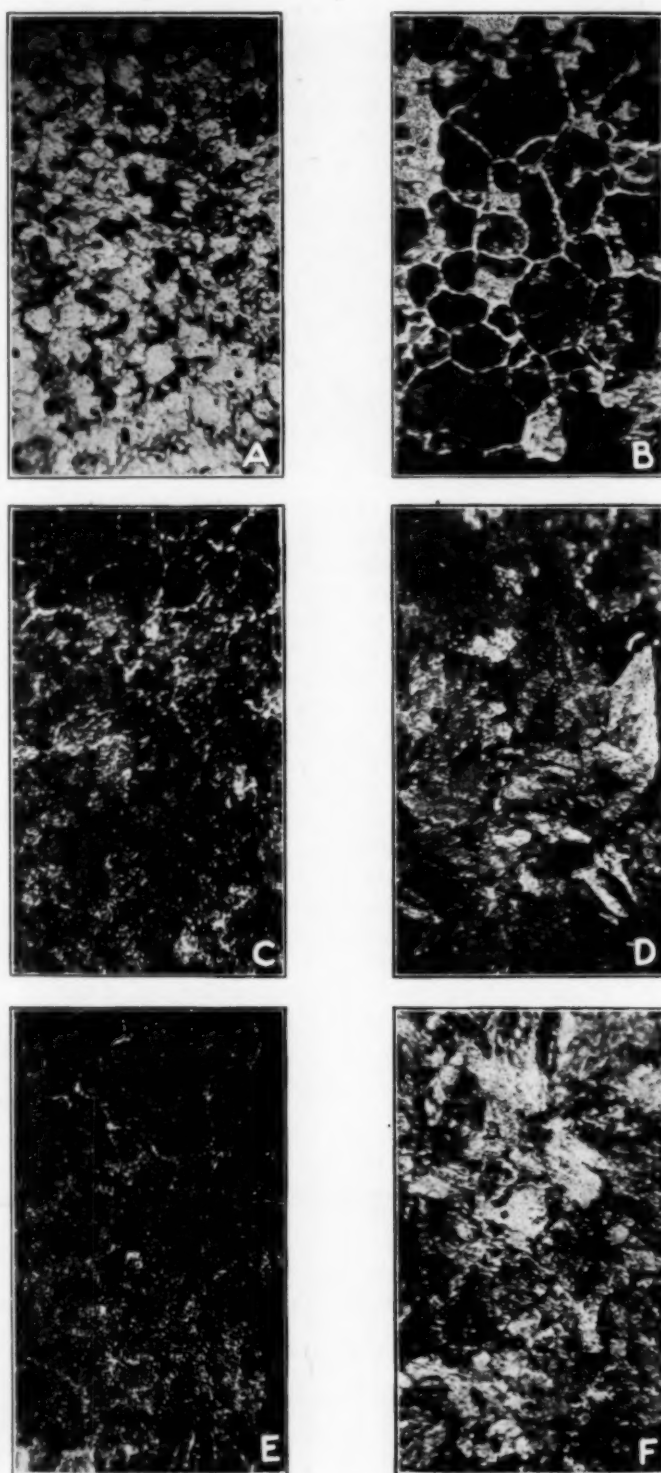


FIG. 6 COMPARATIVE STRUCTURE DEVELOPED BY NITROGEN-BEARING CASE (TO LEFT) AND NITROGEN-FREE CASE (TO RIGHT).

NITAL ETCHING. $\times 350$

Three per cent nickel steel, above.
Three per cent chromium steel, middle.
Three per cent vanadium steel, below.

tically no resistance to the penetration of nitrogen, which occurs in the characteristic patches and needles. The carbon of this case is no higher than 0.30 per cent, but the case was much harder than this amount of carbon would account for. The nitrogen has refined the grain of the case to a great extent compared to the large coarse grain of the center, shown in lower part of micrograph.

In the 1 per cent Ni steel the patches of nitride do not occur as deeply, but the area in which needles

*T. H. Andrew, *J. Iron and Steel Inst.*, vol. 86, p. 210 (1921).

*See footnote 2.

occur is wider, the needles more numerous and the grain is finer. The "penetration" is the same as in 0.5 per cent Ni.

At 2 per cent Ni fewer patches occur and very few needles are seen, but the grain refinement occurs to the same depth as before.

At 3 per cent nickel no patches or needles are seen. Judging by first appearance, there has been no penetration, but on close scrutiny a great difference is seen between the grain size of the case and core. This case is the same thickness (0.060 in.) as in the three preceding examples. The line of change is indicated by the arrow. (Fig. 3, top row, right.)

Nickel, therefore, up to 3 per cent appears to have no effect upon the penetration of nitrogen. The grain size decreases with increasing nickel, as might be expected. The change in metallographic appearance—that is, disappearance of needles and large dark patches—is partly due to this reduction in grain size, but examination under high power discloses an entire change in structure, like that in Fig. 7D of the carbon series, indicating that the nickel increases the solubility of the ferrite for nitrogen and what carbon there is present.

CHROMIUM STEEL

This series was made up, treated just as described in the nickel series, and shown in the middle row of Fig. 3. The penetration is about the same as with nickel. The concentration is greater, however, in all cases and may be due to the greater affinity of Cr for carbon or nitrogen or both. With 2 per cent Cr a decided network appears, increasing in width with increased Cr content. Chromium appears to increase both the penetration and concentration of nitrogen as well as carbon.

VANADIUM STEEL

This element is more active than chromium. The concentration is greater and the hyper-eutectoid zone wider with 3 per cent vanadium than with 3 per cent chromium. (Fig. 3, lower row.) Inserts show photographs of fractures of these three series, the depth of penetration being the same in all regardless of amount or kind of special element.

CHROMIUM-VANADIUM STEEL

A combination of these elements gives the expected result, both penetration and concentration being high. (Fig. 4A and B.)

MANGANESE STEEL

The absorption of nitrogen is high in manganese iron alloys, and of all steels worked with, these are the most brittle after cyaniding. (Fig. 4C and D.)

COMMERCIAL STEELS

Fig. 5 shows various alloy steels containing carbon and cyanided as described above. The carbon has not prevented the special element from exerting its effect.

CARBON CONTENT OF CYANIDED CASES

Analyses of the outer 0.010 in. of the rods shown in Fig. 3, containing 3 per cent Cr, 3 per cent Ni and 3 per cent V respectively, showed 0.34 per cent C in the Cr alloy, 0.24 per cent C in the Ni alloy and 0.39 per cent C in the V alloy, certainly much too small an amount alone to account for the structure shown or hardness obtained.

The difference in structure with nital etching between carburized (no nitrogen present) and cyanided

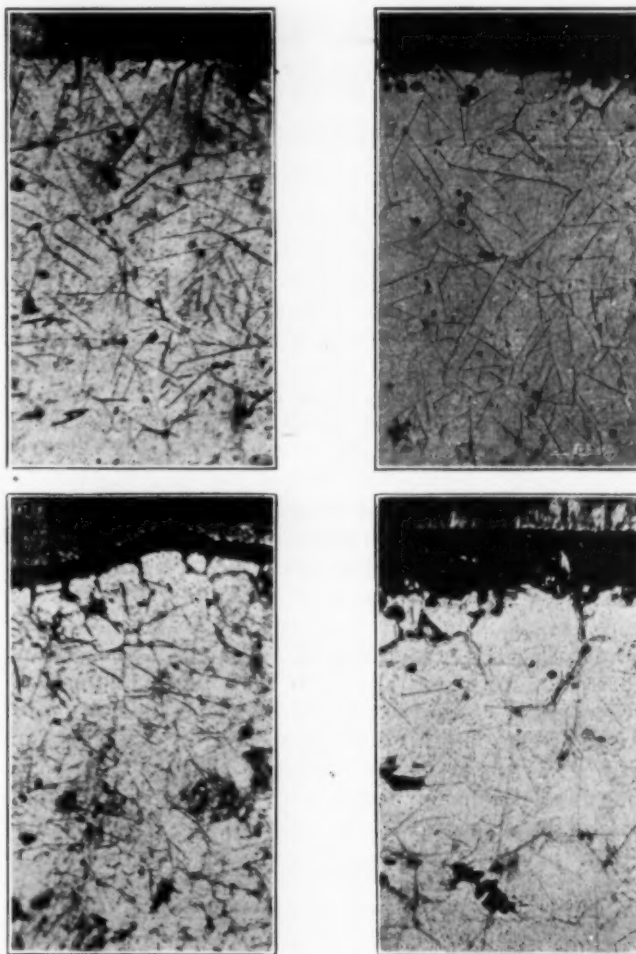


FIG. 7. STRUCTURE CAUSED IN PURE IRON BY PURE AMMONIA (LEFT) AS COMPARED TO THAT DUE TO COMMERCIAL AMMONIA (RIGHT). $\times 200$
Annealed at 450 deg. C., above, and at 650 deg. C., below.

cases is shown in Fig. 6. The carburized cases are about five times the depth of the cyanided case. The section shown is in the eutectoid zone.

CARBON IN NITROGENIZED IRON (NH_3)

Many investigators have assumed that the dark areas herein referred to as "eutectoid" patches must of necessity contain carbon. Strauss first suggested this in working with pure iron treated in ammonia, assuming that the C came from pyridin existing as an impurity in the ammonia. In order to investigate this further two rods of pure iron were treated in tank ammonia and in pure NH_3 . The tank (commercial) ammonia did show a wider black border than the pure ammonia (see Fig. 7), but even with the pure ammonia a distinct black border of "eutectoid" structure was found. It appears that the carbon, if present, does associate itself with this "eutectoid" constituent, but that the presence of C is not necessary to its existence.

SUMMARY

Nitrogen plays an important rôle in case-hardening and greatly reduces the ductility of pieces so treated. Cyaniding is effective in introducing nitrogen, but certain commercial solid carburizers introduce nitrogen to a harmful extent. Nitrogen is not unlike carbon in its micrographic appearance and its action in the presence of added elements such as Cr, V, Ni and Mn, but its micrographic occurrence may be distinguished by the use of Stead's CuCl_2 reagent, used as described.

Schenectady, N. Y.

Legal Notes

BY WELLINGTON GUSTIN

Pearse Patent Held Anticipated and Void by District Court

In the case of the Chipman Chemical Engineering Co., Inc., vs. the Reade Manufacturing Co., the United States District Court for New Jersey held Pearse patent No. 873,680, dated Dec. 10, 1907, void for lack of novelty. Complainant had charged that the patent had been infringed by defendant and asked for an injunction, which was denied. (270 Fed., 679.)

Complainant was in the business of spraying railway tracks with a liquid weed killer by means of the device made under the patent in suit, and during the year 1918 it used 281,320 gal. of liquid on such railways as the Chicago & Northwestern, Lehigh Valley, Baltimore & Ohio, Illinois Central, Southern Pacific, Pennsylvania and others. Defendant was in the same business many years prior to the entrance into it of the complainant.

Complaint was infringement of the fifth and eighth claims of the patent. The fifth claim by analysis consists of three parts—the tank, a discharge device and a means for using pressure. Its eighth claim, in addition to the discharge device, consists of a nozzle pipe with a series of nozzles connected therewith, each containing an independent valve controlling the passage of liquid therefrom. Defendant asserts there is no novelty in either of these claims. Various earlier patents are cited, and Bradford patent No. 803,090, for a hand-car device for destroying weeds along the railroad, the court said, appeared to be a complete anticipation of the patent in suit.

Sale of Goods Before Organization of Company

The Circuit Court of Appeals of the United States, Fifth Circuit, was unable to decide the rights of the parties on questions of law in the case of Bickmore Nitrating Cotton Co. against the Covington Cotton Oil Co. (271 Fed., 80) and remanded the case for a new trial.

The Nitrating company brought suit to recover damages for breach of a contract for the sale and further delivery to it by the Cotton Oil company of 500 bales of cottonseed linters. Defendant admitted the execution of the contract and that plaintiff had lost profits in the amount claimed as damages, but defended on the ground that it was induced to enter into the contract by false and fraudulent representation of plaintiff's financial responsibility, in that it was at the time of the contract a corporation fully organized, with a paid-in capital stock of \$5,000; and that at the discovery of the true facts, defendant elected to, and did, rescind the contract.

The contract was negotiated through a broker who was uncertain whether plaintiff's manager stated the amount of the paid-in capital stock was \$5,000 or \$10,000. There was much conflict in the evidence between the parties in the issues involved. The court held that the difference of \$5,000 as alleged in the answer, and \$10,000 as given in the evidence as to the amount of capital stock paid in, was no material variance, the gist of the defense being false representation.

It appears that the Nitrating company was only in

process of organization at the date of the contract. Its organization meeting had not then been held, according to all the evidence. Plaintiff admitted that only \$500 of its capital stock had been paid in at the time of organization, and that no more than that had been paid in at the time of the negotiations of sale.

Plaintiff was given judgment in the trial court and sought to defend that judgment on the appeal by contending that proof that no capital stock, or a less amount than \$10,000, had been paid in was of no avail, since defendant rescinded the sales contract on the ground that the representation to it was that plaintiff's capital stock had been paid in to the amount of \$10,000.

However, the court pointed out that defendant's letter rescinding the sale did not lay as much stress upon the amount of the capital stock as it did upon the circumstances that there was no capital stock paid in, no corporation organized and no financial responsibility behind plaintiff's obligations.

The court said it could not be well argued that defendant was seeking to save itself from a losing bargain, since it was shown that the price of the linters as sold had not advanced, and were afterward sold to others at the same price as to plaintiff.

On the dispute as to the facts, the court said a new trial was necessary.

Trader May Announce in Advance Circumstances Under Which He Will Refuse to Sell

In a recent suit by the Andrew Jergens Co. against William A. Woodbury Distributors, Inc., for infringement of its claimed rights to the exclusive use of the name "Woodbury" and the registered trade-mark, consisting of a reproduction of a neckless head, upon dermatological preparations and toilet articles, the District Court of the United States for Delaware laid down the rule that the charge that complainant does not come into court with "clean hands" is not a defense which must be pleaded (271 Fed., 45).

As a counterclaim to the suit defendant stated certain facts to show that it was entitled to use the word "Woodbury" or "Woodbury's," together with the "neckless head," on certain toilet articles and preparations, and charged:

"That plaintiff . . . has threatened to and did refuse to deal with, or to sell its products, the products of plaintiff, to dealers . . . and the like, who dealt with defendant, and did otherwise intimidate dealers . . . and the like, into declining to deal with defendant."

The court said the rule to be applied to this proposition is to the effect that a trader or manufacturer may, in the absence of an intent to create or maintain a monopoly, freely exercise his own discretion as to parties with whom he will deal, and that he may announce in advance the circumstances under which he will refuse to sell.

Further the defendant likewise charged:

"That plaintiff . . . has threatened to and did refuse to deal with . . . trade journal publishers, . . . who dealt with defendant. . . ."

The court says this charge is too vague, indefinite and uncertain to show a cause of action in the defendant against the plaintiff. It may mean no more than that plaintiff declined to advertise in trade journals carrying the advertisements of the defendant, and if so, without further facts, it was acting within its rights by such refusal.

The Relation of the Chemical Engineer to the Manufacture and Application of Automobile Finishes*

Some Chemical Engineering Developments in the Paint and Varnish Industry Which Have Resulted From the Demand for the Large-Scale Manufacture and Application of Automobile Paint, Enamel and Varnish Products

By C. D. HOLLEY, Ph.D.

Director of Research, Acme White Lead & Color Works

LESS engineering, particularly chemical engineering, has been devoted to the paint and varnish industry than to any of the other modern industries of similar magnitude. As late as the beginning of the present century, at which time many of us were just beginning our professional careers, it would have been very difficult to have cited or discussed any engineering feature connected with the paint or varnish industry that was worthy of mention. Perhaps some will be inclined to challenge this statement and point to certain of the industries whose products are used in the manufacture of oils and colors, but I refer primarily to the paint and varnish industry in itself.

A late start oftentimes results in increased progress, and this is particularly true of the paint industry. It has outgrown many of its rule-of-thumb methods and procedures and is now using some genuine engineering in the manufacture of paint, enamel and varnish products and in their application.

The rapid developments in the automobile industry, especially as related to quantity production, have necessarily had their effect on the manufacture of paints and varnishes and have been perhaps the most potent influence in the development of this industry from an engineering standpoint.

Although the paint industry is frequently considered as separate from the varnish industry, both are closely connected and in the larger plants they are in fact regarded as separate departments of the same industry. The modern paint and varnish plant compares favorably as to size with the representative plants of other industries. The larger plants have a daily production capacity of 10,000 gal. or better of varnish and 12,000 to 20,000 gal. of paints and enamel products.

In the manufacture of the ordinary types of paint, of which house paint is a typical example, the liquid or

vehicle is essentially raw linseed oil, and the procedure of combining the pigments and the oil is rather elementary. In automobile finishes raw linseed oil as such is but little used, the vehicle being always in the nature of a varnish or grinding japan—i.e., composed of heat-treated oils, fused resins, metallic driers and volatile thinners, of the kinds and in the quantities the manufacturer considers necessary.

After the gums and oils have been "run" on the fire for the requisite length of time, which varies with the character of the products used and the requirements, the kettles are removed from the fire and allowed to cool until the temperature has dropped sufficiently to



FIG. 2. ALLOWING KETTLES TO COOL PRIOR TO ADDING THE VOLATILE THINNERS

permit the addition of the volatile thinners. In Fig. 1 is shown the older but still common type of varnish stack under which the gums are melted with no attempt to recover volatilized fumes. The kettles shown in Fig. 2 are being cooled in the open air. A portion of the melting and cooling room in a modern plant equipped with recovery apparatus is shown in Fig. 3. After the varnish has been thinned and is cool it is run through a press or a centrifugal clarifier and stored to age.

GRINDING PIGMENTS AND COMBINING WITH VEHICLE

The grinding of the pigments with the varnish vehicle for automobile coatings is accomplished in several types of mills. The mill most commonly used is the flat stone mill, 20 in. in diameter, the stones being water-cooled.

Recently a new type of mill has come into use. This is shown in Fig. 4. It resembles the previous type of mill, but instead of the rolls touching each other, each roll which is of granite is bedded individually in a half round block of granite, the contact between the roll and its bed furnishing the grinding surface.

After the enamel has been ground in the form of a



FIG. 1. THE OLD TYPE OF VARNISH-MAKING INSTALLATION

*Abstracted from a paper presented before the Detroit Meeting of the American Institute of Chemical Engineers, June 20, 1921.

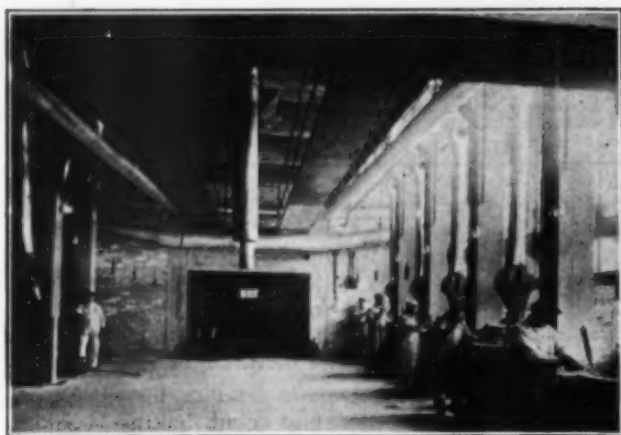


FIG. 3. PORTION OF MELTING AND COOLING ROOM IN A MODERN VARNISH PLANT

paste, it is thinned by the addition of the requisite varnishes and volatile thinners and then strained to free it from dirt particles or else run through a clarifier. Clear varnishes, baking japans and auto coatings containing pigments of low specific gravity such as carbon or lampblack pigments are now handled by means of a clarifier.

USES FOR CENTRIFUGAL CLARIFIERS

Centrifugal clarification permits the paint manufacturer to prepare many of his automobile coatings free from dirt particles, small "liver" formations and any coarse pigment particles and therefore enables the user to obtain a smooth, uniform finish, free from specks or spots without having to rub down the coats. This treatment also enables the automobile manufacturer to keep the varnish and enamel coatings in his dipping tanks and collecting tanks continually freed from particles that would speck the surface. It has been the experience of one manufacturer that prior to the installation of such a system more than half of his finished product was returned by the inspectors for further rubbing down and afterward it was reduced to less than 5 per cent. It is very generally conceded that the introduction of centrifugal clarification in connection with modern application devices, such as the

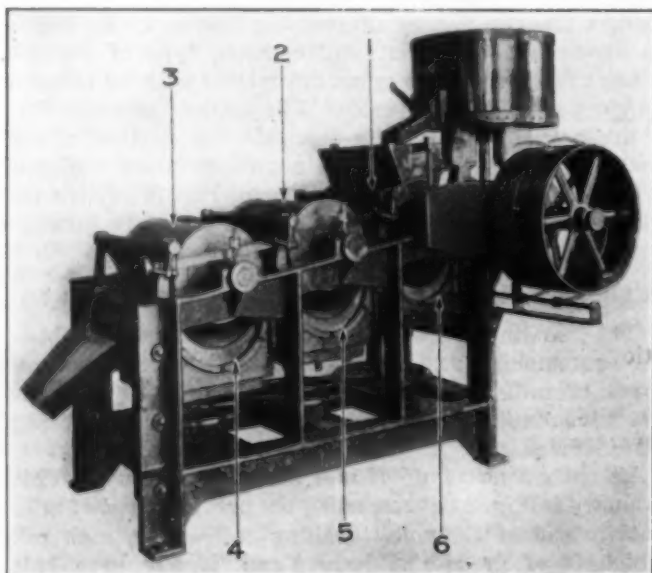


FIG. 4. THREE-ROLL MILL FOR GRINDING PIGMENTS
1, 2, 3—Hard granite rolls, 4, 5, 6—Half-round hard granite beds leaded in cast iron.

use of the "floco," has resulted in a saving of more than 80 per cent in labor costs for finishing, to say nothing of the elimination of wastage. Fig. 5 shows a typical installation of a clarification system.

The pigment materials used in varnish manufacture or the technique of combining the vehicles with the pigments have not been discussed in detail, as these are well known and do not present any engineering practice worthy of mention in the present limited treatment of the subject.

FUME COLLECTION

There is, however, one feature in connection with the varnish industry that deserves special attention. Varnish making is a very old industry and the varnish maker has been content to go about his business without bothering himself about any chemical engineering requirements. Recently he has changed his mind, because in several instances he had his choice of closing down permanently, moving his plant at a heavy financial

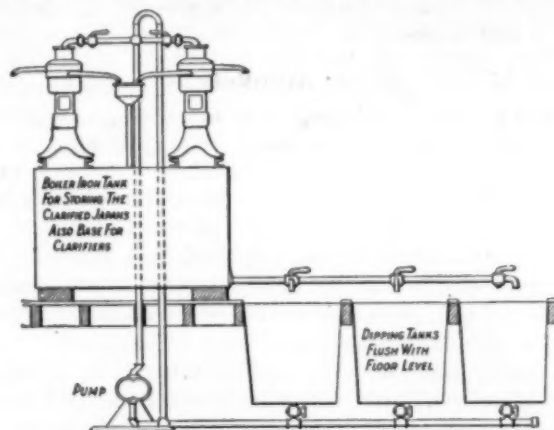


FIG. 5. DIAGRAM SHOWING INSTALLATION OF CENTRIFUGAL CLARIFIERS

loss, or getting out of his trouble by resorting to the services of a chemical engineer.

Most varnish plants were built either in a manufacturing section or in the outskirts of the cities away from the residential sections, but with the growth of the cities, many of these plants have found themselves surrounded by residences, the occupants of which object to the large volumes of fumes emitted from the varnish stacks. From 10 to 25 per cent of the weight of the varnish gums used is driven off in the melting of the gums. These products of decomposition pass up the varnish stacks and are disseminated in the air in quantities that sometimes reach several thousand pounds daily.

This has necessitated the installation of an efficient fume control system whereby these fumes can be condensed as they leave the kettles or be made to enter into a chemical combination and thereby be eliminated. This has required some really ingenious chemical engineering practice, as the problem was not an easy one to solve, because of the physical and chemical nature of the fumes and because of the fact that the gums are "run" in the varnish kettles at nearly their flash point; any undue disturbance in the equilibrium of the gases in the kettle often meant a bad fire. Two views of recovery apparatus are shown in Figs. 6 and 7. These installations have proved quite successful, affording usable byproducts, and in several instances have permitted a 50 per cent reduction in the insurance premiums and, not least, have permitted the varnish maker

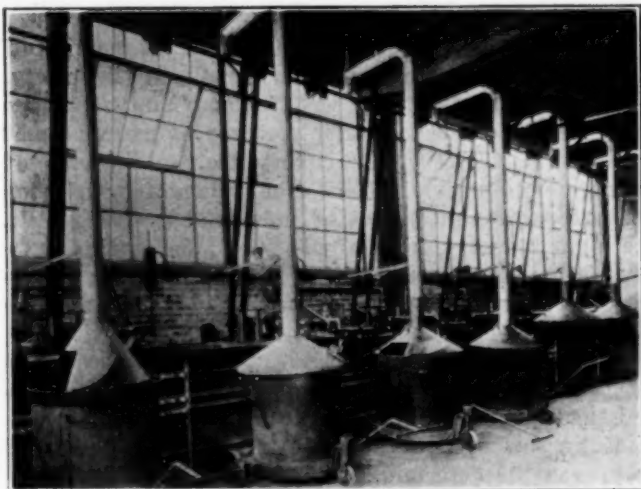


FIG. 6. THINNING RECOVERY APPARATUS

to continue the manufacture of his products undisturbed by the authorities.

APPLICATION OF AUTOMOBILE FINISHES

The systems of finishing and the methods of application developed by the automobile industry have a very close relation to modern engineering practice. There are many variations in details in the leading automobile plants depending on the experience of the finishers in charge, on the production schedule as related to the floor space available, on the price allowed for the job and especially on the labor- and time-saving devices installed. The last named have resulted from the research of chemical and other engineers.

Possibly no two devices have done so much toward reducing the cost of auto coatings as the "spray" and the "floc." Their introduction and use have accomplished wonders in the automobile industry in the way of quantity production, and due credit should be given the chemical engineer in bringing about the results obtained. The amount of work that can be accomplished by the spray over hand brushing varies considerably, depending upon the nature of the parts and the conditions under which the work is done. It is conservatively estimated that it does the work from a minimum of twice as fast and ranging from this figure up to seven times as fast as can be done by an experienced brush hand. It is used for applying the undercoatings on bodies, quite generally for all chassis work and more or

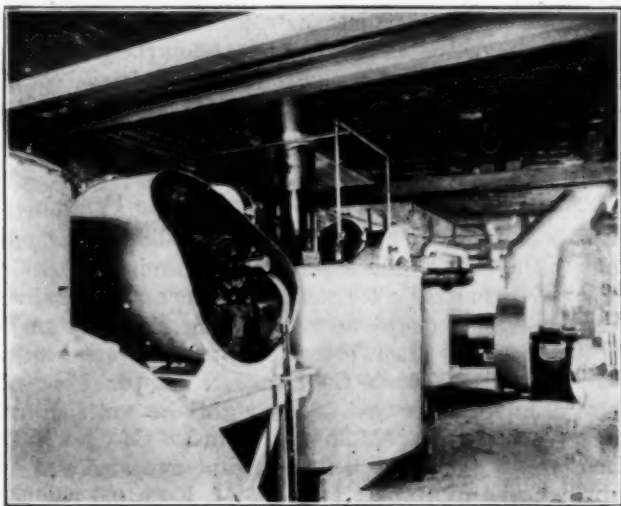


FIG. 7. VARNISH FUME RECOVERY APPARATUS

less on the wheel jobs. The "floc" is used for flowing on the finishing coats and in some instances the color coats on bodies and can be used on fenders and hoods as well. On open body work the cost of application has been reduced to 30 to 40 per cent of the previous cost.

DIPPING, BAKING AND DRYING

The application of baking japans by dipping and then baking at comparatively high temperatures was well understood before the automobile industry became a commercial factor. Generally the parts dipped were quite small and could therefore be easily handled. When the automobile plants went into quantity production, the application of baking japans to fenders, hoods and other parts together with the subsequent baking operations required extensive installations. Our present-day procedures are the result of extensive engineering research. Much ingenuity has been expended in labor-saving devices for dipping and protecting the dipped articles from dust while draining and then conveying them mechanically through the ovens. An intermittent conveyor and a dip used for fenders are shown in Fig. 8.

The time of baking has been shortened by systematic temperature control. The dangers of the old direct gas-fired oven with which there was always a risk that a burner might go out, fill the oven with gas and the

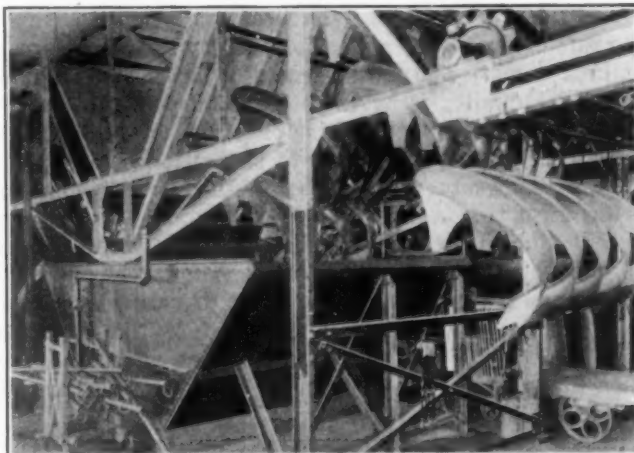


FIG. 8. DIPPING AUTOMOBILE FENDERS PRIOR TO ENTERING BAKING OVENS

mixture explode with disastrous consequences from ignition with another burner have been eliminated. The indirect method of heating in which each burner is inclosed in a separate combustion box with a separate vent from the oven is reasonably safe and does not contaminate with soot and other foreign particles the articles being baked. More recently electric baking ovens have come into extensive usage. I shall hold no brief for either the gas or the electric. Each have their advantages and disadvantages. There is still room for considerable improvement; in the larger baking installations the temperature is not as uniform as desirable throughout the cross-section of the oven to get maximum production. Much has already been done to overcome this trouble, and it appears to be only a question of time when a closer uniformity will be obtained.

The drying time of a paint, enamel or varnish varies with atmospheric conditions and, since it does vary, it necessarily follows that there must be at least one definite condition under which the coating in question will dry most rapidly and successfully. Moreover there are many different coatings to be dried and each coating contains different proportion of oxidizable oils.

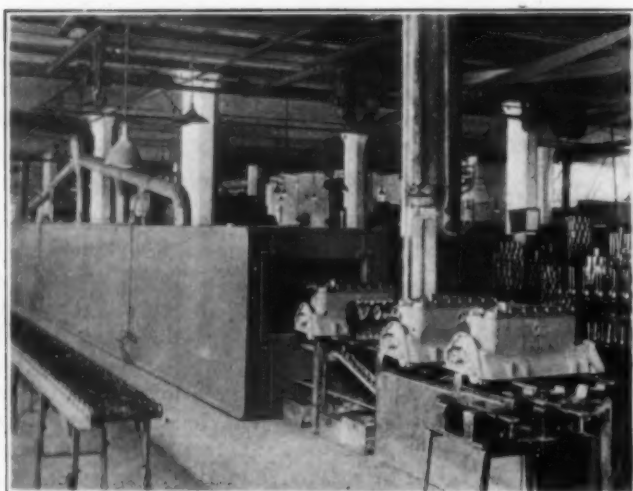


FIG. 9. EXIT OF GAS-HEATED OVEN FOR AUTOMOBILE ENGINE PARTS

This, then, is the problem that confronted the automobile engineer and the engineers who have been developing the artificial drying systems.

When artificial drying was first considered, it was the general belief that moisture would retard rather than hasten the drying process. Investigation has proved the contrary, that definite percentages of moisture in conjunction with the heat materially increased the rate of drying over that obtained by the same degree of heat alone. The most successful method of controlling the humidity is by the so-called dew point control, which operates on the principle that the amount of moisture which air can carry at saturation is dependent on the temperature of the air. For instance, having determined that a humidity of 42 per cent at 120 deg. F. is required, it is found that this corresponds to an absolute humidity of $14\frac{1}{2}$ grains per cubic foot, which is the amount present in a cubic foot of saturated air at 90 deg. F. (dew point), and therefore the humidity control device is set at 90 deg. F., the current of air then being raised to 120 deg. F. after passing through the humidifier.

Considerable difficulty was at first experienced in obtaining uniform results with the light colors such as the light blues, yellows, grays and whites. These colors frequently showed marked variation under artificial drying from that obtained by ordinary air drying. More recent developments have proved that by varying the humidity these troubles can be overcome. For example, a light blue job dried at 130 deg. F. with 35 per cent humidity had a greenish overcast, whereas another body with the same varnish, at the same temperature but at a humidity of 45 deg., dried to exactly the same color as an air-dried job. I have cited these instances to show that the artificial drying of an enamel or varnish requires engineering skill.

CONCLUSION

In conclusion I wish to state that the paint maker and the paint engineer have co-operated whole-heartedly with the automobile and equipment engineers, and to meet the requirements of the various installations I have discussed has been no easy undertaking. It has meant the developing of enamels and varnishes of entirely different characteristics especially as regards their physical properties. The accomplishing of this has been of very material benefit in placing the paint and varnish industry on a more scientific basis.

Detroit, Mich.

Practical Applications of Electrometric Control

Dr. Paul E. Klopsteg, addressing a recent meeting of the Chicago Section of the American Chemical Society, cited the increasing number of important industrial applications for electrometric methods of measurement and control. This is particularly true in the case of hydrogen-ion determinations, the value of which has been recognized in scores of industrial processes. In the sugar industry, for example, one of the serious problems is the clarification of the raw juice before evaporation is started. This is accomplished by adding lime water to the juice and careful neutralization with CO_2 or SO_2 . The hydrogen-electrode method has been successfully used in controlling this process. In the sirup and sugar industry, two other problems have been successfully solved with the hydrogen electrode. One of them was the determination of acidity caused by fermentation in molasses and sirups. In this instance an indicator is of little use, because of the color and opacity of the sirup. In the preparation of glucose from starch, the neutralization of the acid with which the starch is digested can be satisfactorily controlled electrometrically.

The acidity of plant and fruit juices, both as regards actual acidity and total available acidity, is easily measured by similar methods. Work of this sort has been done by some of the large canning companies which are also studying the effect of fruit juices upon the cans, using the hydrogen electrode in their investigations.

The Bureau of Standards some years ago investigated the effect of H-ion concentration upon deposits obtained in metal plating baths and demonstrated the importance of this factor. In addition to these applications Dr. Klopsteg referred to problems in a number of other industries, of which the following is a partial list:

In the baking industry, fermentation takes place only within certain limits of p_H and there is an optimum value of acidity.

In filtration problems, especially of gelatinous material, there is a particular hydrogen-ion concentration at which the volume occupied by the material is a minimum. The same considerations apply to some problems of gelatin manufacture.

In the leather industry, the actual acidity in the various tanning processes is the controlling factor affecting practically all of the important properties of the finished leather.

Much of the recent progress in the manufacture of dentifrices has come about through the discovery that the actual acidity of toothpaste is an important factor in determining the effect of the paste on the teeth.

In the textile industry, hydrogen-electrode control has been exercised for wool-scouring liquors, in cloth finishing, and in the application of dyes.

Alsatian Potash Mines Returned to France

The Colmar Court of Appeal has delivered a judgment in the case of the Alsatian potash mines by which they are definitely returned to France. A business man, M. Koch, bought certain mining rights from the German company just before the mines were sequestered by the French Government. Later M. Koch claimed only 0.6 per cent of the rights he had acquired, but the tribunal of Mulhouse awarded M. Koch the whole area. The French Government appealed and the Colmar Court of Appeal awarded M. Koch 0.6 per cent of the mines and returned the remainder to France.

Radium Production in America—II*

Electroscopic Analysis of Radium-Bearing Products—Preparation of Standard Samples Used in the Standardization of the Electroscopes—Description of the Apparatus and Methods of Operation

By H. D. d'AGUIAR

THE electroscopic laboratory is of primary importance in a radium production plant. Without accurate determinations from this laboratory the work in the plant can never be anything but guesswork; whereas when it is functioning properly the progress of the work at each stage is accurately known. In a laboratory, such as this, where determinations of radioactivity are constantly being made, it is imperative that all samples of active matter be kept sealed in order to prevent possible radioactive contamination by the escape or spilling of radioactive material. The presence in the laboratory of highly active samples such as the sulphates and carbonates resulting from the different stages of the extraction process and samples from the crystallizing laboratory, or tubes of radium, will vitiate the measurements made.

All the chemical and manipulative work on the various samples received should be performed in a portion of the laboratory separate from that where the measurements are made, so that any accident causing the escape of emanation or the spilling of radium-bearing material shall not cause the contamination of the laboratory. While the errors of measurement caused by the escape of emanation are largely temporary, the continual escape of emanation will result in the walls becoming active due to the products of slow decay derived from the emanation.

It will be necessary so to plan the work of the laboratory that the determination of radium content of ores, sand tails and similar materials, by means of the alpha electroscopes, will not be taking place at a time when tubed radium for estimation by gamma ray is present in the laboratory. Neither can tubed radium be present when readings are being made with the emanation electroscopes used for determining the strength of carbonates, sulphates or the samples of dissolved crystals and mother liquors.

ALPHA RAY DETERMINATIONS

The apparatus for these determinations is a small electroscopes provided with a scale and a microscope by which the rate of fall of the leaf can be timed. One electrode extends through the case, terminating in an insulated handle, while the other passes through the amber insulation at the bottom of the head into a metal chamber below the head. This chamber is provided with a door permitting the samples to be measured to be introduced and removed easily. The container for the samples is made by providing a circular disk of metal about $\frac{1}{8}$ in. thick having a circular opening in the center about $\frac{3}{4}$ or 1 in. in diameter, with a metal tray into which the disk fits firmly, thus forming a space for the samples of a fixed area. This container

can be readily taken apart for cleaning after each determination. As the alpha rays have no penetration, even a cigarette paper stopping their passage, the principal point to be observed is that a definite area of the sample and standard be exposed, and not that a definite weight be used.

The electroscopes may be charged with batteries or by a static charge generated with an ebonite rod or amber. Charging with a battery, however, is always preferable. A battery of about 300 v. potential will be required. The metal casting of the electroscopes is grounded, as is one pole of the battery, while the other is attached to the charging arm of the electroscopes. Upon turning this against the leaf holder and switching on the current, the leaf system will be charged. When so charged the fall of the leaf is watched through the microscope and the time required for it to fall a definite number of divisions on the scale is recorded with a stop watch. A record is made of the time in seconds and of the number of divisions. From these figures the number of divisions which the leaf will fall is calculated and recorded as the natural leak of the instrument in divisions per hour.

METHOD OF OPERATION

The standard ore, on which the amount of uranium has been determined by chemical analysis, is placed in the sample holder, carefully leveled and all particles removed from the surrounding metal by means of a small piece of cotton. The holder is handled as little as possible, only the edges being touched with the fingers. The sample prepared, it is placed in the chamber of the electroscopes and the door closed. The electroscopes is then charged and the time required for the leaf to fall through the same space as was selected for the determination of the natural leak is taken. The standard is then removed, the holder cleaned and freed from any trace of ore by wiping with small bits of cotton. The sample of the unknown ore which is to be analyzed is then placed in the holder in the same manner. It is placed in the electroscopes and the time taken for the leaf to pass through the same divisions as were selected for the standard is recorded. The same holder must be used for the three readings. Example:

Time required for the leaf to fall 10 divisions on the scale = 480 seconds.

$480 \div 10 = 48$ seconds per division.

3,600 seconds in 1 hour; divided by 48 = 75 divisions per hour = natural leak of the instrument used.

With the standard (say 3 per cent uranium oxide) the time required for leaf to fall 10 divisions = 120 seconds.

$(3,600 \times 10) \div 120 = 300 - 75$ (natural leak) = 225 divisions per hour.

With the unknown sample the time required for leaf to fall 10 divisions = 100 seconds.

$(3,600 \times 10) \div 100 = 360 - 75$ (natural leak) = 285 divisions per hour.

Therefore: 225 : 285 :: 3 : x; and $x = 3.52$ per cent.

*For Part I see CHEM. & MET. ENG., VOL. 25 NO. 18, 1921, p. 825

The radium-uranium ratio in unaltered ores being a constant and 8 lb. of uranium oxide being equivalent to 1 mg. of radium, it is necessary only to know the total weight of the ore analyzed to compute the radium content in milligrams.

The control analysis on the sand tails is made in the same manner. The sample of the tails as received at the laboratory is dried over night (or until dry) in a drying oven at 105 deg. C. The sample is then ground in an agate mortar, if necessary, to reduce it to about the same grain size as the standard used. The determination is then made immediately and the results are reported to the plant for guidance in the dissolving work.

DETERMINATIONS BY EMANATION METHODS

The determination of radioactivity by the emanation method is used for samples of sulphates, carbonates, dissolved crystals and mother liquors.

The electroscopie used for emanation determinations consists of the usual electroscopie head mounted on an air-tight container, of about 10 liters capacity, provided with adjustable legs for leveling, a circular spirit level being mounted on the top of the head. The container is fitted with two gas-tight stop-cocks located on opposite sides of the container. One is placed near the top and the other near the bottom of the container. The head screws on and the joint is gas tight. The electrode extends through the amber insulation at the bottom of the head and is long enough to reach nearly to the bottom of the container. It is preferable to have the bottom of the container removable to facilitate cleaning should the electroscopie become contaminated.

STANDARDIZATION

Before determinations can be made it is necessary to standardize the electroscopie by means of emanation from a known quantity of radium. A small tube of radium containing about 1 mg., which is in equilibrium and has been carefully estimated by gamma comparisons with a standard tube, is opened and dissolved carefully in sulphate-free water containing about 1 per cent barium chloride and hydrochloric acid. This solution is then made up to volume in a 1-liter volumetric flask with dilute acidified barium chloride water and constitutes the standard stock solution. A quantity of this stock solution equivalent to about 1 microgram of radium is accurately pipetted off and diluted to 1 liter with acidified barium chloride water in a second volumetric flask. Several portions (one for each electroscopie to be standardized) are pipetted off and transferred to tall aspirating bottles of about 250-c.c. capacity. The portions pipetted should be equivalent to about 40 millimicrograms of radium. The radium solution in the aspirating bottles is then diluted to about 100 c.c. with dilute acidified barium chloride water. The bottles are marked with the exact amount of radium they contain. These are the standardizing solutions. Each standard is then de-emanated by attaching it to an air pump. The air passing through the radium solution is drawn from outdoors and the air and emanation drawn off and passing through the pump are also passed outdoors by an outlet pipe through the wall. By so aspirating vigorously for 20 minutes all the emanation is removed. The intake-cock is then closed and the pump permitted to create a strong vacuum in the bottle. When this is done, the outlet stop-cock is closed and the exact time noted and recorded on the bottle.

Each bottle is treated in the same way. The bottles are permitted to stand for at least 3 days and 20 hours before being used for standardizing. The radium comes into equilibrium with the emanation in 30 days, the half period being 3.85 days—that is, one-half the total emanation is formed in 3 days and 20 hours. Therefore, knowing the exact time at which the radium was totally de-emanated and the time at which the emanation is again separated from the radium and transferred to the electroscopie for standardization or measurement purposes, the fraction formed in the elapsed period of time can be definitely calculated from tables prepared by actual determinations throughout a period of 30 days. The accompanying table gives the constants of growth and decay which are used in calculating the amount of emanation formed for any intermediate period.

GROWTH AND DECAY OF RADIUM EMANATION

T = time. X = fraction of emanation remaining after time T . Y = fraction of equilibrium amount formed in time T .

T	X	Y	T	X	Y
0	1.0000	0.0000	5 days	0.4066	0.593
1 hr.	0.9925	0.0075	6 days	0.3396	0.660
2 hrs.	0.9851	0.0149	7 days	0.2837	0.716
3 hrs.	0.9777	0.0223	8 days	0.2369	0.763
4 hrs.	0.9704	0.0296	9 days	0.1979	0.802
5 hrs.	0.9632	0.0368	10 days	0.1653	0.834
6 hrs.	0.9560	0.0440	11 days	0.1381	0.861
7 hrs.	0.9489	0.0511	12 days	0.1153	0.884
8 hrs.	0.9418	0.0582	13 days	0.0963	0.903
9 hrs.	0.9347	0.0653	14 days	0.0805	0.919
10 hrs.	0.9277	0.0723	15 days	0.0672	0.932
11 hrs.	0.9208	0.0792	16 days	0.0561	0.943
12 hrs.	0.9139	0.0861	17 days	0.0469	0.953
13 hrs.	0.9071	0.0929	18 days	0.0392	0.960
14 hrs.	0.9003	0.0997	19 days	0.0327	0.967
15 hrs.	0.8936	0.1064	20 days	0.0273	0.972
16 hrs.	0.8869	0.1131	21 days	0.0228	0.977
17 hrs.	0.8803	0.1197	22 days	0.0191	0.980
18 hrs.	0.8737	0.1263	23 days	0.0159	0.984
19 hrs.	0.8672	0.1328	24 days	0.0133	0.986
20 hrs.	0.8607	0.1393	25 days	0.0111	0.988
21 hrs.	0.8543	0.1457	26 days	0.0093	0.990
22 hrs.	0.8479	0.1521	27 days	0.0078	0.992
23 hrs.	0.8416	0.1584	28 days	0.0065	0.993
1 day	0.8353	0.1647	29 days	0.0054	0.994
2 days	0.6977	0.3023	30 days	0.0045	0.995
3 days	0.5827	0.4173	40 days	0.0007	0.999
4 days	0.4868	0.5132	50 days	0.0001	0.999

Example: If the emanation formed by the standards, or by any sample, is transferred to the electroscopie 3 days and 20 hours after sealing, the fraction of the equilibrium amount of emanation formed will be:

Value of X for time T (3 days) = 0.5827.
Value of X for time T (20 hours) = 0.8607.
Therefore $X = 0.5827 \times 0.8607 = 0.5015$.

Standardizations are never made with standards which have not reached the half period, and it is even preferable to use standards which are in equilibrium.

METHOD OF OPERATION

About 1 hour before the time at which it is desired to transfer the emanation from the standard to the electroscopie the apparatus is thoroughly de-emanated by drawing air from outdoors through the container of the electroscopie by means of the air pump. The container is kept under a slight vacuum by opening the inlet tap only half way, while the outlet to the pump is opened fully. After 10 minutes the pump is cut off and when air has passed in sufficient amount to bring the pressure in the container to normal the inlet tap is closed. The electroscopie is then charged, either with the battery or with the ebonite rod, and the natural leak of the instrument is determined by timing the fall of the leaf over the full scale and recording the value obtained in divisions per hour. The pump is then turned on and the outlet tap of the electroscopie is opened. The inlet tap remains closed, thus creating a strong vacuum in the container. The vacuum is carried as far as is possible with the pump at hand. A manometer is attached to the inlet tap and the same vacuum is applied for every determination. When evacuated, the taps are closed, the pump and manometer are detached, and the

delivery tube of a drying bottle containing dry calcium chloride is attached to the inlet tap. The other tube of the drying bottle, which reaches to the bottom of the bottle, is attached to the delivery tube of the sample bottle containing the standard. The other tube of the standard bottle, which dips into the liquid, is attached to the pipe delivering air from outdoors. The stop-cock of the delivery tube of the standard bottle is opened and inlet tap of the electroscopes container is partly opened. When the two vacuums balance the air inlet stop-cock on the standard bottle is slightly opened, thus permitting the vacuum to be filled and drawing the emanation from the standard bottle into the electroscopes container. When the vacuum is filled, as shown by the ceasing of the bubbles at the end of the tube of the standard bottle which dips into the liquid, the inlet tap of the electroscopes is immediately closed. The electroscopes containing the emanation is then allowed to stand for 3 hours. At the end of this time it is charged and the time required for the leaf to fall is taken with a stop watch and recorded. This done, the electroscopes is immediately attached to the air pump and the emanation removed by drawing air from outside through it exactly as was done previous to taking the natural leak. The drying bottle is also de-emanated in the same way. The drying bottle should be refilled with fresh calcium chloride after using two or three times. The standard is again de-emanated and sealed and put aside for future standardizations. The electroscopes should be restandardized regularly once a month. The standards can be used over and over providing none of the liquid splashes beyond the stop-cocks during transfer of the emanation to the electroscopes.

The time required for the leaf to fall is converted into divisions per hour and the divisions per hour of the natural leak are subtracted. Thus the following facts are obtained for each electroscopes: (a) Natural leak in divisions per hour. (b) Millimicrograms in standard used. (c) Divisions per hour for standard.

Where the standard used is not in equilibrium, the divisions per hour for the standard are recorded as being produced by the fractional equivalent of emanation formed in the time which the standard has stood since de-emanation and sealing. Thus if the standard contains 40 millimicrograms of radium and has stood 3 days and 20 hours since sealing, when the emanation formed is transferred to the electroscopes, because in that time one-half the equilibrium amount of emanation will be formed, the divisions per hour for the standard are recorded as having been produced by 20 millimicrograms of radium in equilibrium.

PREPARATION OF SULPHATE SAMPLES FOR ANALYSIS BY THE EMANATION METHOD

The samples of sulphates as received at the laboratory are sent to the section of the laboratory where the chemical work is done. Here they are first dried in an oven at 105 deg. C. The dried sample is ground finely in an agate mortar. One gram is then accurately weighed and ground together with 3 g. of a mixture containing 20 per cent ammonium chloride, 30 per cent barium chloride and 50 per cent lampblack. This mixture is transferred to a small iron crucible. The last traces of the mixture are removed from the mortar by means of a small bit of tissue paper and added to the mixture in the crucible. It is then covered with an iron lid, placed in a muffle furnace and roasted at a temperature of 1,050 deg. C. for 1½ hours. The crucible

is removed and cooled. It is carefully opened and the contents removed to a small beaker containing dilute hydrochloric acid and barium chloride. The crucible is carefully washed out with dilute acidified barium chloride water and the washings are added to the main solution in the beaker. The solution is then diluted to about 50 c.c., carefully boiled for 10 minutes, and filtered into a tall 250-c.c. sample bottle. The residue of carbon on the filter paper is washed with dilute acidified barium chloride water. The residue on the paper is then mixed with another 3 g. of the lampblack mixture and the roasting repeated. This is to insure the complete reduction of all sulphates to sulphides. The mixture when cool is dissolved in dilute acid barium chloride water, filtered and added to the main solution in the sample bottle. The solution should now measure about 100 c.c. The ground-glass stopper carrying the closure cocks and aspirating tube is then carefully inserted and the sample de-emanated by aspirating as were the standards. Fifteen minutes of aspiration is sufficient. The air inlet tap is then closed and the pump allowed to create a vacuum in the bottle. When this is done, the tap is closed and the time noted.

ANALYSIS OF SULPHATE AND CARBONATE SAMPLES BY THE EMANATION METHOD

Each sulphate sample bottle when de-emanated and sealed is delivered to the section of the laboratory having charge of the electroscopic work. They are allowed to stand for 3 or 4 days before estimation. When ready for estimation, the natural leak of the electroscopes is taken and the emanation from the sample transferred to the container of the electroscopes in the same manner as the emanation from the standards. The emanation is allowed to stand in the electroscopes chamber for 3 hours. The leaf is then charged and the time of fall recorded with a stop watch. The calculation of the results is made in the following manner:

From the standardization it is known that

Time of fall of the leaf for 20 millimicrograms = 300 divisions per hour.

The natural leak of the instrument = 75 divisions per hour.

Therefore the rate of fall due to the standard = 225 divisions per hour.

Time of fall for natural leak taken just before introducing the sample = 8 minutes, which = 75 divisions per hour.

Time of fall for sample = 60 seconds.

So 60 seconds = 600 divisions per hour minus the natural leak of 75 divisions per hour = 525 divisions per hour for the sample.

Therefore 225 : 525 :: 20 : x

x = 46 millimicrograms.

As the sample has stood (for example) 3 days and 20 hours, the factor as determined from the table is 0.50.

$46 \div 0.50 = 92$ millimicrograms of radium per gram of sulphates.

Or, $(454 \times 92) \times 1,000,000 = 0.0417$ mg. of radium per lb. of sulphates.

The electroscopic laboratory is usually furnished with the total weight of sulphates and the percentage of moisture which they contain by the analytical laboratory, so that the calculation of the number of milligrams in the entire lot is easily made from these figures.

The samples of carbonates as received at the laboratory are sent to the chemical section of the laboratory, where they are first dried at a temperature of 105 deg. C. The dried material is then thoroughly mixed. A 1-g. sample is then weighed off and dissolved in dilute hydrochloric acid containing barium chloride. The solution is boiled carefully, cooled somewhat and then filtered into a tall 250-c.c. sample bottle. If the sample

does not dissolve to a perfectly clear solution, the residue, which will consist mainly of unconverted sulphates, is incinerated in a small iron crucible, mixed with 3 g. of the lampblack reduction mixture, reduced in the muffle furnace and prepared for estimation exactly as described under the procedure for sulphates. In such cases there will be two samples for each determination, one representing the soluble portion of carbonate, and the other the insoluble portion or sulphate present. The samples so prepared are allowed to stand for 3 to 4 days. The emanation formed is then transferred to the electroscope and estimated just as was done with the sulphate samples.

The radioactivity is figured in the same way. The milligrams of radium found in the carbonate portion of the sample plus those in the insoluble or sulphate portion give the total activity of the material.

The insoluble portion is an index of the completeness of the carbonation process and should always be very small when the work has been properly carried out.

OTHER ANALYSES

The samples of the gelatinous silica press cakes submitted for analysis are prepared for analysis by the chemical section of the laboratory in the same manner as the samples of sulphates. It will usually be necessary to take a 2-g. sample for analysis.

The samples of dissolved crystals will be received at the laboratory marked with the volume of the sample and the volume of the liquid which each sample represents. The samples in 200- to 250-c.c. capacity volumetric flasks are prepared for determination by the chemical section of the laboratory. The operator preparing the sample will have to judge what fraction of 1 c.c. of the original sample or how many c.c. to pipette off for analysis and base his judgment on the usual radium content of the different fractions of dissolved crystals with which he is dealing and so proportion his samples that they will represent 60 millimicrograms or so as a maximum. This amount of the sample which has been made to definite volume is then pipetted into a sample bottle and made up to about 100 c.c. with dilute acidified barium chloride water. This sample is then de-emanated, sealed and delivered to the electroscopic section for estimation after standing 3 or 4 days. The results are computed to milligrams per c.c. and the amount present in the total volume of liquor is also reported.

Samples of the mother liquors from the different fractions in the crystallizing laboratory will be received stating the volume of the mother liquor which they represent. These are prepared for estimation by the chemical section in the same manner as the samples of dissolved crystals. As they are weaker in radium content, a correspondingly larger sample will be taken for analysis. The samples are then de-emanated, sealed and sent to the electroscopic section, where they are estimated after standing for 3 to 4 days.

All volumetric flasks, beakers, sample bottles and other containers used for containing the samples in any of the chemical manipulations are invariably washed thoroughly with water and then with dilute acidified barium chloride water before using. This is to insure freedom from any sulphate. Any water containing sulphates in solution would immediately vitiate the results by precipitating radium-barium sulphate. A stock solution containing 15 per cent barium chloride and 15 per cent concentrated hydrochloric acid is kept on hand

and about 100 c.c. per liter of this solution is added to all the water used in preparing samples for analysis. Under no circumstances should an untreated distilled water be used.

GAMMA RAY DETERMINATIONS

The electroscope used for gamma ray determinations is a small electroscope provided with a microscope and is similar to the one used for alpha ray determinations except that it has no chamber for holding samples. The electroscope is mounted on a long board provided with a metal track. A sample holder is made which slides along the track so that it may be set and held at a fixed distance from the electroscope by means of a lock nut. The varying of the distance is necessary, as the samples examined will be of widely different strengths, and samples of high radioactivity will have to be set at a longer distance from the electroscope so that the fall of the leaf will not be too rapid to time accurately. A large lead screen about $\frac{1}{4}$ in. thick is mounted between the electroscope and the sample holder to cut off all alpha and beta rays.

The determinations are made in the following manner: The tubes of radium will be received at the laboratory marked with their number indicating the fraction from the crystallizing laboratory which they represent and which will also be an indication of their probable radium content, and with the time at which they were tubed and sealed. The tube to be estimated is kept in a lead container made for the purpose and located in another room at some distance from the electroscope. The natural leak of the instrument is then taken by charging the leaf with the battery or an ebonite rod and timing the fall over the whole scale or over half the scale. The result is recorded in divisions per hour. A standard tube of radium is then laid on the sample holder and the time required for the leaf to fall over the same portion of the scale as was selected for the determination of the natural leak is recorded with the stop watch. The standard tube is then removed and replaced in the container where tubes under estimation are kept and the tube to be estimated is placed in the sample holder, being careful not to change its distance from the electroscope. The rate of fall for the unknown tube is then determined in the same manner and over the same portion of the scale. This done the time is noted and the tube is returned to the container. The calculation is then made as follows:

Natural leak for 10 divisions on the scale = 480 seconds = 75 divisions per hour.

Standard tube (10 mg.) requires 120 seconds = 300 - 75 (natural leak) = 225 divisions per hour for the standard.

Unknown tube requires 40 seconds = 900 - 75 (natural leak) = 825 divisions per hour.

Therefore $10 : 225 :: x : 825$ and $x = 32.2$ mg.

When the tubes estimated are not in equilibrium, the result so obtained is divided by the factor equivalent to the age of the tube reckoned from the time of tubing to the time of making the reading. Thus if 3 days and 20 hours has elapsed from the time the tube was sealed until the time it was read, the factor will be 0.50 and the number of milligrams as found in the above example are divided by this factor. Thus $32.2 \div 0.50 = 64.4$ mg. of radium in equilibrium.

The final readings are made on the tubes when they have reached equilibrium. They are then ready for such disposal as the producing company may wish to make of them.

New York City.

Electric Smelting of Iron Ore

BY FRANK HODSON

President Electric Furnace Construction Co., Philadelphia

A STATEMENT was made at a recent meeting of the officers of the American Mining Congress in Washington by Charles W. Potts, mine operator, of Bearwood, Minn., that "Present known reserves of high-grade iron ore, based upon constantly expanding requirements of the steel industry, will be exhausted in twenty years, and the merchantable grades of iron from the great mines of Minnesota will be, at the present rate of depletion, practically exhausted within the next fifteen years unless new discoveries are made."

The tremendous significance of this rapid depletion of native high-grade iron ore has not yet been fully realized, but a glance at the capital invested in iron and steel and kindred industries and its importance nationally will make anyone see the gravity of the situation. As in the olden days the possessors of metals ruled the world, so today control of iron is inseparably linked with world leadership. If, as Mr. Potts states, our available high-grade iron ore will be depleted in twenty years, is there also not a grave danger of our position today in the world's markets passing, unless the vast deposits of iron sands and low-grade ores in this country are properly exploited? Other countries—China, Japan, Brazil, India—with cheap labor, have immense deposits of iron ore. They have water power available and already are installing large smelting furnaces operated electrically for reducing the iron ores.

COMMERCIAL FEASIBILITY OF ELECTRIC SMELTING OF LOW-GRADE IRON ORE

The electric smelting furnace—using cheap water-generated power—will very probably in the next few years open up a vast supply of iron ore at present considered almost worthless. Immense deposits of iron sands and low-grade ores occur in the Atirondacks, on the Pacific Coast and in many other parts of the country. These ores are at present useless, as they cannot be economically treated in the ordinary standard blast furnace. Most of these deposits are in places where power is, or could be generated very cheaply; the ore can be concentrated and smelted into iron by specially designed electric furnaces.

The one thing essential after the financial backing is obtained is the selection of the right type of equipment for the work. Many previous attempts to smelt these ores electrically have failed, owing to wrong or no proper technical advice. A recent issue of *The Foundry* stated there are no less than seventy so-called "direct" processes for making steel direct from ore. Some of these are feasible under certain conditions, but they should not be attempted except on advice from disinterested metallurgists who have had practical electric smelting experience. These "direct" and "secret" processes to give steel direct from ore are the snag that has sunk many promising ventures.

There are several known and proved processes for electric iron smelting, chief of which is the Swedish Electrometall process. Already twenty-seven large installations, with a total capacity of 100,000 kw., are running or under construction in various parts of the world. This type of electric smelter uses the gases generated in the melting zone to preheat and partly

reduce the charge; it does not attempt to make steel direct, but in several cases the product is being tapped out into metal mixers or open hearth furnaces and from there into finishing electric furnaces. Dr. Stansfield in his report on the commercial feasibility of electric smelting of iron ores in British Columbia, writes:

"In Sweden the Electrometall type of electric smelting furnace has proved very satisfactory for the production of low-silicon pig iron. This is, as far as I am aware, the only type of electric furnace that has ever attained commercial success in the production of pig iron from ores. If a permanent smelting plant were being erected, the Swedish type of furnace would be selected."

Considerable publicity has been given recently to what was termed a recent Japanese discovery that iron sand and low-grade ores could be smelted and made into steel. There is nothing new in this invention; as long ago as 1907 John T. Jones, of Iron Mountain, Mich., had devised a similar process for treating low-grade ores. H. A. Greaves and H. Etchells, English scientists and inventors of the successful "Greaves-Etchells" electric steel furnace, also brought out a process a few years ago, in which black iron sand was passed down a rotating tube or kiln and from there to a finishing electric furnace. The ore in this tube is preheated and partly reduced by the gases given off in the electric furnace, and finished steel from sand and has repeatedly been made by their process.

A French inventor, Monsieur Basset, uses a similar method, but in his case external or additional heat is applied to the ore proceeding through the preliminary tube.

ADVANTAGES OF ELECTRICALLY MADE PIG IRON

As long as high-grade ore is available and coke reasonable in price, these electric processes of ore reduction cannot hope to compete with the standard blast furnace in anything but charcoal iron—or iron of special analysis. With the falling off in available supplies of high-grade ore and the generation of cheap electric power from water power, the electric smelters will come into their own. They can undoubtedly make iron superior in quality to that made in the standard blast furnaces. Very thorough tests made in Sweden and England with this electrically made pig iron also proved that by its use in the open-hearth furnaces considerable time could be saved in the steel-making operations. Actual figures have not been published, but in a number of cases that came directly under the writer's notice the saving in time per heat of steel was between 1½ and 3½ hours.

Although, therefore, the initial cost of electric pig iron may still be somewhat higher than ordinary blast-furnace pig iron, yet considerations such as that mentioned above and the extreme purity of the electric iron do not make the difference in first cost as large as would at first appear.

The electric smelter can also economically handle a very large proportion of turnings, borings and cheap scrap in its charge—material that is not suitable except in small proportions in the standard blast furnace.

In places like the Pacific Coast, where good ore is available near cheap, water-generated electric power and where at present most of the coke, pig iron or

steel has to carry heavy freights from the East, there is a splendid opening for someone with vision ahead to put down electric smelters and steel plant.

COMMERCIAL FEASIBILITY OF ELECTRICALLY MADE STEEL

Probably the future method of making even cheap steels will be to take hot blast-furnace metal, either from electric or standard blast furnaces, directly into a large metal mixer where additions of ore, cheap borings and turnings could be added, from there to a bessemer converter, where the metal would be given a partial blow only, and the deoxidizing and finishing off would be done very quickly in a series of electric furnaces.

In the process outlined there would be practically no loss of heat in the whole operation, the addition of ore and cheap scrap in the form of borings, etc., in the mixer would cause a thermic reaction and generation of heat, the bessemer operation would add more heat, and all that the electric furnace would have to do would be to deoxidize, adjust temperature and, where necessary, refine or make additions of alloys. The writer is confident this process would make the cheapest steel in the world.

Ceramics as a Byproduct of Coal Mining in Sweden

BY J. W. BECKMAN

AT A recent meeting of the Chemical Society of Sweden C. Crouquist showed that Sweden has a very ancient coal industry as well as a well-established clay industry. In Skane, the southernmost province of Sweden, coal has been mined ever since the fifteenth century. In those early days the coal was brought out for domestic use only, and from small seams, and it was not until 200 years later that active commercial mining operations took place. The coal veins that had been mined were very thin and the larger mining operations forced the abandoning of the early workings, finding wider veins. These were discovered at Höganäs, which place has since developed into a large industrial center.

The coal is of a more recent formation than that occurring in England and Germany and is found at depths from 10 to 100 m. The thickness of the coal seams vary from 30 to 60 cm. In between the coal seams there are clays and carboniferous slates. These clays have to be mined simultaneously with the coal to make it economical and feasible to bring it out.

The ash content of the coal varies from 5 to 50 per cent and more. It is free from sulphur and phosphorus and has all the characteristics of "sub-bituminous" coal. The railroads and industries of Sweden use the best qualities, although they are also used to some extent for domestic heating. The low grades are used as a source of energy at Höganäs and for the burning of clay products.

The clay-products manufacture is now the main operation at Höganäs. The clay, originally a waste product, has become of prime importance, and the quality of the products produced from it has become famous not only in Sweden but in many other countries. Firebricks, paving bricks, common building bricks, chemical ware, acid-proof bricks, terra cotta products, sewer pipes, sanitary ware and household articles are all being made. These products are pro-

duced in a simple way. The carbonaceous shales are piled in the open and set on fire. They burn completely, leaving a dense well-burned chamotte which is very desirable for the manufacture of pressed brick and other clay products.

The company operating the works at Höganäs also operates an electric furnace plant at Trollhättan, where alundum and carborundum are produced, and these products are used here as elsewhere in the manufacture of highly refractory bricks. Electrodes are also a product of this plant, their manufacture being virtually a ceramic industry, though utilizing different raw materials.

The accumulation of a large quantity of low-grade coal prompted one of the engineers of the Höganäs company to experiment for the purpose of finding a use for this material. He worked out a simple process for the reduction of iron ore at a low temperature by means of these inferior coals, producing a very pure iron sponge, well adapted, on account of its purity, to the manufacture of high-grade steels.

At the present time about 7,000 kw. is generated at the mine from low-grade coals. This energy is used by the industry itself and is also supplied to the adjacent countryside, and this power plant acts as a standby for one of the hydro-electric companies.

The total annual capacity of the plant is 450,000 tons of coal, 200,000 tons of clay, 150,000 tons of firebrick, 400,000 tons of sewer pipes, 7,000 tons of electrodes, 12,000 tons of iron sponge, as well as considerable quantities of other products.

Beckman & Linden Engineering Corporation,
San Francisco, Cal.

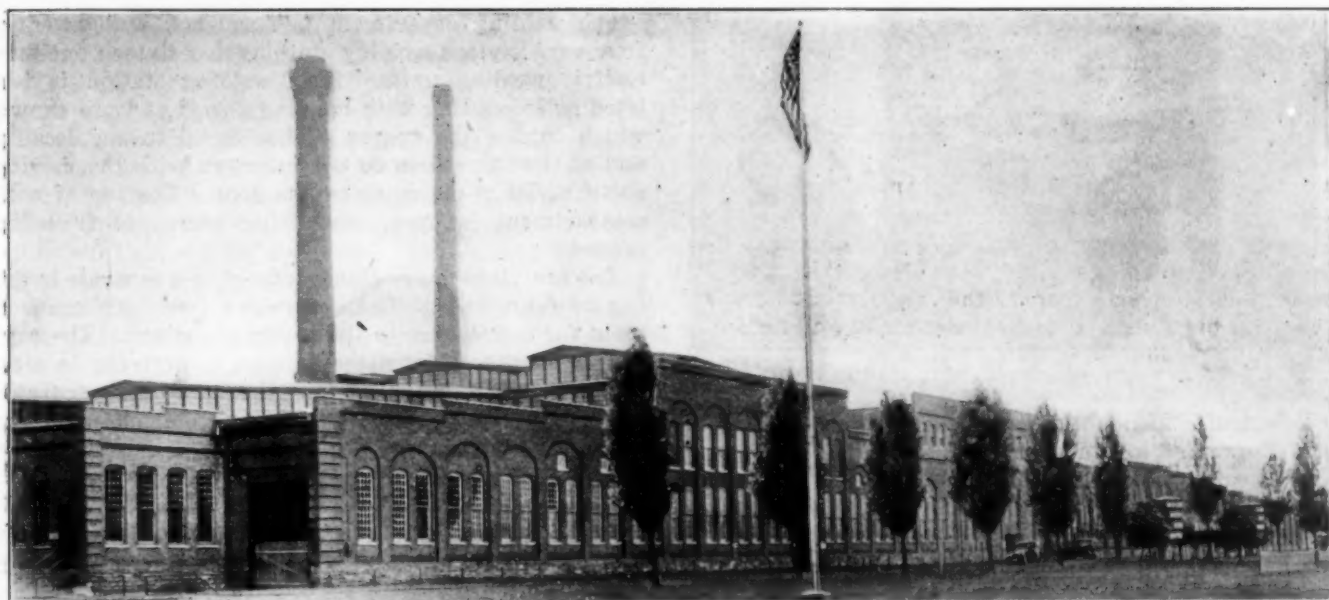
Switzerland as a Market for American Goods

American manufacturers and exporters are overlooking an important field for business development in Switzerland, says American Trade Commissioner H. Lawrence Groves in a special survey of the markets of that country published recently by the Bureau of Foreign and Domestic Commerce of the Department of Commerce.

In his report published as a convenient handbook of Switzerland, the Trade Commissioner calls special attention to the increased importance of that country as a financial and a commercial center. He says that Switzerland, located in the heart of Europe, is essentially an industrial nation, almost entirely lacking in raw materials. Consequently, its many industries are dependent on foreign countries for supplies of raw materials as well as for many semi-manufactured and finished products. In his opinion, supplying these commodities is of sufficient importance to merit much more intensive consideration than heretofore accorded on the part of our exporters.

The report is devoted to Switzerland exclusively. It reviews the country's industries, finances, natural resources, markets, etc. Conspicuous facts in its foreign trade are mentioned specifically. There is also information about advertising, credit and transportation agencies, and other similar trade factors.

The complete report is known as Special Agents Series 210—"Switzerland—A Commercial and Industrial Handbook." Copies can be purchased at 40c. each, from the Superintendent of Documents, Government Printing Office, Washington, D. C., and from the district and co-operative offices of the Bureau of Foreign and Domestic Commerce.



ENAMELED STEEL PLANT OF PFAUDLER CO., ROCHESTER, N. Y.

ENAMELED STEEL MANUFACTURE

Development of Glass-Lined Steel Containers—French Plate Glass First Employed—Enamel and Industrial Application Research Involved—Fabricating and Finishing the Steel—Mixing and Firing the Enamel—Erection and Auxiliary Departments

By CHESTER H. JONES

THE origin of the glass-lined tank or sheet steel enameled container may properly be traced to the need for large containers in the brewing industry, where many sanitation difficulties were encountered in the preparation and storage of malt liquors. At the time the Pfaudler Co. decided to manufacture enameled tanks for this purpose there was no idea of producing the present-day complicated constructions such as steam-jacketed kettles, vacuum pans, etc. These have come as a development from the time when all enamels on containers of any size were applied to cast iron.

Preparatory to undertaking the manufacture of large brewery tanks a comprehensive investigation was carried out. Enamelers were consulted and it was found that the formulas extant were simply the product of rule-of-thumb experiments. These formulas reposed in the memories of individual enamelers rather than in written scientific data. One well-known class of enamel was made originally by taking ordinary rock chips from a granite quarry, grinding them to a powder and fusing to the metal to produce granite ware. Other methods were quite as crude, making conditions difficult for the manufacture of vessels of any size.

The first attempt was made with a cast-iron tank which went into a specially built furnace in 1887. At the end of the heat the door was opened, revealing a melted mass of cast iron. With this failure and since all formulas purchased from so-called scientific enamelers had failed, the company made a radical departure from the accepted methods and started to experiment with sheet steel.

In the process of this research French plate glass was first used as a basic enamel material. The plate was imported from France, broken up, the fragments ground to a fine powder and fused to the steel vessel. This was fairly successful and marked the origin of the glass-lined tank. The high cost of the imported plate caused the company to turn to the purchase of French bottle glass from the leading perfume manufacturers in the United States. This method was employed in the actual manufacture of glass-lined tanks for about fifteen years, during which time experiments to find other methods were continued and the organization was developed. Real scientific handling of the problem from the standpoint of the present state of the art began in 1908, and since that time the methods have been developed to the most modern stage of production. Research in the truly advanced interpretation still continues.

RESEARCH LABORATORY

The first building in evidence on entering the plant of the Pfaudler Co., at Rochester, N. Y., houses the research and control laboratory and is shown in Fig. 1. The work involved here requires a staff of ceramists, chemists and metallurgists, for the metal to be enameled must be studied in relation to the metallurgical properties which affect the ceramic properties of the coating, and the chemist must discover the chemical values best suited to the use of both. The building contains all the departments of this work, including chemical laboratory; balance room equipped, besides the balances, with a Thwing instrument for determining the expansion co-



FIG. 1. VIEW OF RESEARCH LABORATORY

efficient of glass; photographic dark room, and micro-metallographic laboratory.

The furnace room for testing is equipped with a two-crucible furnace for studies in enamel composition, and a large semi-muffle furnace. Here is also a drier for the pebbles. All of these are heated with gas fuel with draft furnished by low-pressure air. The grinding room is equipped with large and small pebble mills and is adjacent to a well-stocked enamel-compounding room. The welding experimental laboratory has, with other apparatus, an electric-welding outfit, made by the General Electric Co. The latest development here is the furnishing of an industrial application room for studying the application of enameled ware in relation to the materials in the many industries where it goes to make up the process equipment.

FABRICATING THE STEEL

The first step in the production of enameled steel is the shaping of the vessel from the steel sheet. The raw material arrives at the factory in flat rectangular or circular steel sheets varying in thickness from $\frac{3}{4}$ in. to $\frac{1}{4}$ in. or less. The dished heads for tanks are formed from the circular sheets on three hydraulic presses after previous heating in a coal-fired reverberatory furnace. Views of these pieces are shown in Figs. 2 and 3. Fig. 2 is a partial view of the steel layout room, while Fig. 3 is one of the stock rooms with the above-mentioned hydraulic presses showing in the background. Two overhead traveling cranes run the length of the fabricating department.

Bending rolls of various sizes are employed to form the circles for large vats from the flat plate. Some of these pieces appear in the left foreground of Fig. 2. The ends are welded to form a complete ring after rolling. Bevel shears cut bevels on the two edges for welding.

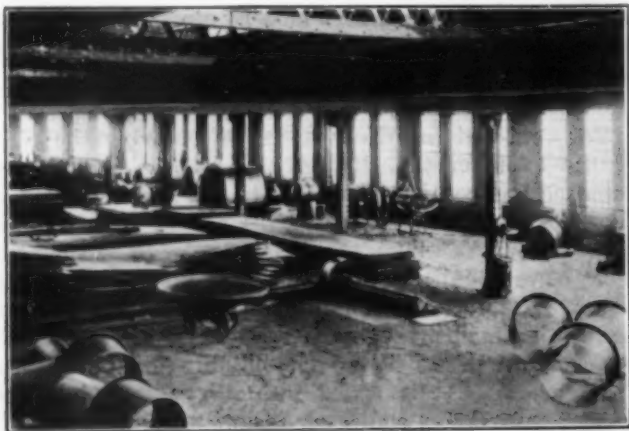


FIG. 2. VIEW OF STEEL LAYOUT ROOM

The welding department is furnished with twenty-four oxyacetylene welding stations and sixteen one-man electric welding units. Each welding station is isolated by separating with hanging sheets of loose canvas which confine the sparks of hot metal to one locality and at the same time do not interfere with the moving about of large pieces along the floor. The top of each compartment is open, permitting access to traveling cranes.

The acetylene gas is manufactured in a separate building in four units. The generators feed to a common main for conveyance to the welding stations. The oxygen is purchased from the Linde Co., arriving in steel bottles. These are placed in the acetylene generator house and likewise connected to a common main for the welding station.

GRINDING AND FLANGING

After the welding the surplus metal at the joint is removed by grinding. Fig. 4 shows a movable emery wheel equipment for such work on the interior of tanks. Rings which make up the sides of large sectional tanks or in cases where the cover must be bolted or riveted



FIG. 3. STEEL STOCK ROOM

must next be run through the flanging machine, one of which appears on the left in Fig. 5. The equipment is made to special design of the Pfaudler Co. It will turn the cold metal to an angle of 90 deg. with the side, and flange one edge of a ring or both edges simultaneously.

Following this operation the rings are trued in a rotary shear. The flanges are subsequently punched on machines which pierce ten holes at one operation.

SAND BLASTING

Before the enamel coating is applied, it is essential that the steel surfaces be thoroughly cleaned. Fig. 6 shows the operation in one of the six large sand blast rooms. The blasting equipment consists of blowers, excess dust removers and sand-conveying and storage equipment.

The sand-blast treatment is sufficient, since it removes grease, rust, oxide and all other foreign matter. At the same time a fine surface is given to the steel for the enameling operation.

The enamel is prepared and applied by both the wet and the dry process. There are in general four different coatings used depending upon the service to which the ware is to be subjected. One is supplied for the

malt industry only; the dairy, soft drink and pharmaceutical trade use another type; the third enamel is designed to resist all and any degree of acidity, and finally a special coat is used which is more decorative and while not compounded to combat acid has a reasonable resistance to it.

Raw materials ordinarily used are ground sand, quartz, feldspar, borax, cryolite, fluorspar, sodium and potassium compounds, and clay. The method of melting French plate glass onto the steel sheet has long been abandoned and the constituents which go to make up a glass as mentioned above are made in the form of a powder. The required proportions of each for a definite enamel are mixed, smelted together, and ground wet in ball mills to form a slip which may be applied to the steel surface with spraying machines.

The basis of all enamels is SiO_2 , which is obtained in the ground sand, quartz or feldspar. Borax or anhydrous boric acid (B_2O_3), like silica, is an essential

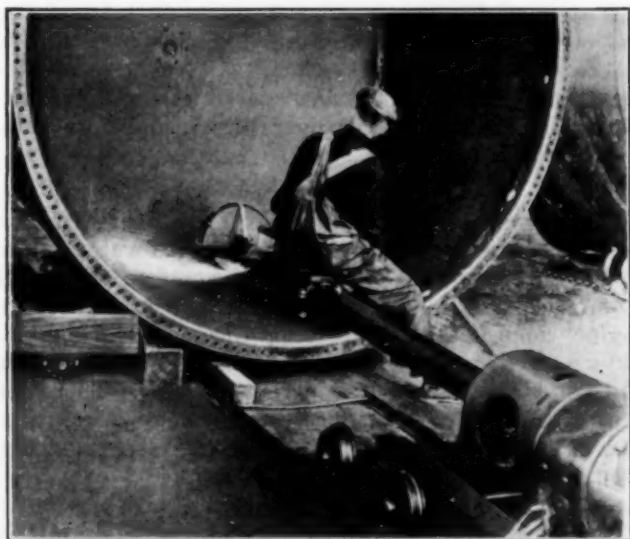


FIG. 4. GRINDING WELDED JOINTS

constituent of enamel with the possible exception of acid-proof enamels. Those enamels which contain no borax are much more difficult to apply to the metal. Cryolite functions in the mix as both a flux and an opacifier. Fluorspar is also an active flux. Barium carbonate of a pure grade produces finished coats of high luster and density, and gives the easy fusibility of lead without the poisoning feature attending the use of the latter. The action of zinc oxide is similar to that of barium carbonate. Sodium and potassium salts are active fluxes, the nitrate of soda being most frequently used.

The raw materials for making the frit are mixed by hand or in revolving drums. Thorough mixing by machinery is the more advisable, especially in making white enamels where the quality is inversely proportional to the length of time spent in obtaining a thorough melt. Fine grinding and mixing as accomplished by ball mills insure a uniform fusion product with the shortest time in the melting furnace. Five Abbé pebble mills and four special rotary smelters comprise the glaze room apparatus.

The enamel mixture is melted and fined in the smelting furnace until no lumps of unfused or undissolved material can be detected in the string of glass drawn from the melt. On cooling, the frit from the furnace is broken up and ground wet in pebble mills. During

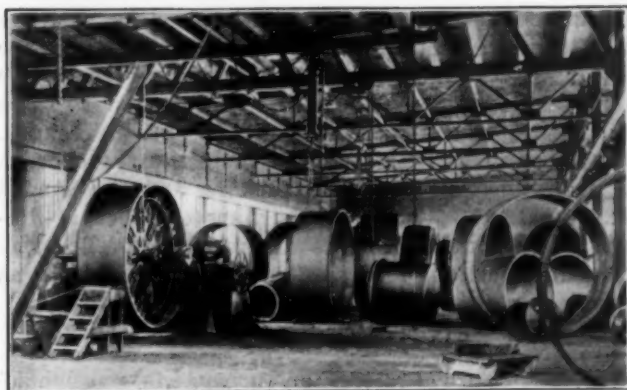


FIG. 5. FLANGING MACHINE

this operation a flocculating agent such as magnesium sulphate, clay or borax is added to increase the viscosity of the slip.

Ordinarily wet enamels are sprayed on the heavy pieces through the medium of a portable air spray nozzle guided by the hand of the operator. Chemical plant ware may be treated by the dry process, or dusting. In this case the metal surface is wetted and the dry powdered frit dusted on where it adheres to the water film. The dusting method has the decided advantage over the wet process in the production of acid-resisting wares, for no raw materials are added to the frit. These raw materials in an enamel lower the acid resistance, for while an enamel is a glassy coating it is not a solid glass and becomes less solid with the addition of raw materials which may not completely fuse with the frit during the brief operation of burning the enamel to the steel.

FURNACE ROOM

The equipment for burning enamel to the steel consists of a total of seven furnaces, four of which are the open type, two complete muffle type and one vertical furnace of special design used for firing small articles that would involve waste of heat if treated in the large furnaces. This furnace consumes oil for fuel, the remainder burning coke. Natural draft is obtained by high stacks. One of the larger furnaces with door raised appears in Fig. 7.



FIG. 6. SAND BLASTING

Muffle furnaces are employed largely for burning light wares, especially the light enamels, while the heavier steel pieces are fired in the open type. The temperatures range from 1,500 to 2,000 deg. F. The temperature in any one firing depends on the enamel. Hoskins pyrometers record the temperatures of each furnace. The combustion chambers are constructed from silica brick, while the burning chamber is firebrick throughout. All doors are made up of firebrick blocks and steel and are operated by compressed air, as seen in Fig. 7.

ENAMEL APPLICATION ROOM

Adjacent to each battery of furnaces is one enamel application room. The coated ring or tank is picked up by a traveling charging crane and placed in the open-type furnace, where it is revolved on a turntable while burning. Two of these charging machines are operated by electric current, while others have air lift for the vertical movement and electric drive for the lateral operation. The muffle furnaces are served by power tongs, which pick the pieces from tables moving on industrial tracks along the front of the battery and place them within the burning chamber in each case. Pieces are also served to these tongs by an overhead electric crane paralleling the industrial track just mentioned. Part of one of the traveling tables is seen in the lower right in Fig. 7. The overhead crane is operated from a floor station near the furnaces.

The special upright circular kiln noted above is charged through split doors in the top and is equipped

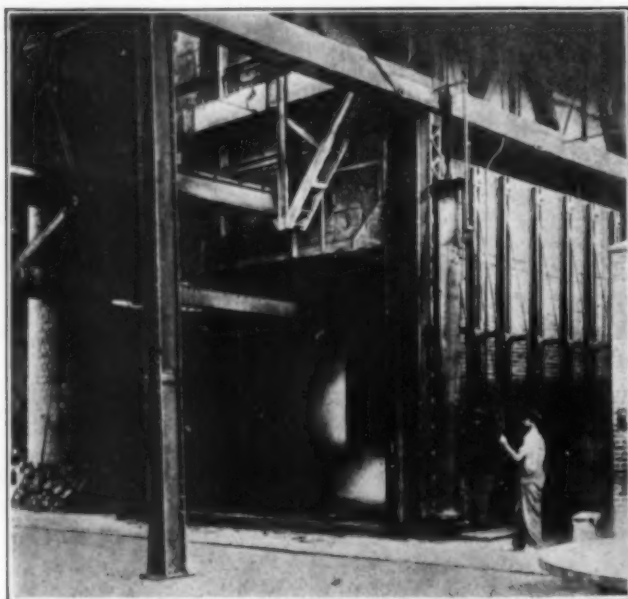


FIG. 7. ENAMELING FURNACE

with two firing holes located in the side near the bottom. The waste gases from all furnaces is conducted through waste heat boilers in the power plant. The charging cranes were all designed by the company's engineers.

ERECTING DEPARTMENT

The burned wares next go to the erecting department, where assembly is made and packing accomplished in accordance with the customer's specifications. Fig. 8 shows a corner where tanks of certain sizes are built up. The department has six one-man electric welding stations which operate mainly in attaching the jackets to jacketed pans and tanks. One section is given over



FIG. 8. ASSEMBLY FLOOR

to detail assembly of sprays, motor and gear brackets, agitating mechanisms, etc. A portable electric welding station is operated in fastening the various details to the main body at this location. All surfaces are inspected and tested for enamel perfection and the mechanical devices are given operating trial before shipment.

POWER HOUSE

All the steam needed is furnished from three Wickes waste heat boilers. Two Worthington feed-water pumps and a Cochrane feed-water heater complete the boiler room equipment. Power is generated in one Nordberg engine connected to a Western Electric Co., 250-kw., 230-v., direct-current generator and one Westinghouse unit 200-kw., 230-v., direct-current machine. There are five Ingersoll-Rand steam-driven air compressors, three of which furnish air for the sand-blast plant and two supply air for operating furnace doors and tongs. A six-panel switchboard controls the electrical apparatus. All the power consumed in the plant is generated in this department.

AUXILIARY OPERATIONS

Other departments of the plant include a large machine shop, with planers, lathes and drill presses, which is supplemented by repair stations located throughout the various process departments; complete woodworking plant; stores department; hospital and first aid stations; painting shop for coating the unenameled portions of the apparatus; large-scale development of the laboratory department for research in applications to the industries, and finally the factory offices, engineering department and drafting rooms.

CONCLUSION

The plant is conveniently located for shipment of raw materials and products over the Erie Barge Canal, the New York Central, and Buffalo, Rochester & Pittsburgh railroads. It is well arranged for flow of process and ideally located for the health and morale of the working forces. The product is widely marketed to the food, pharmaceutical, dairy, beverage and other chemically-controlled industries.

The company through its research department has made a special study of these industries, with a view to meeting their requirements and developing the equipment accordingly.

Further continuous investigation must obtain to meet new needs in the rapid present-day development of scientifically operated industrial plant processes.

Firefoam Protection of Extra-Hazardous Risks in Manufactories

BY DUNCAN M. PATTERSON, M.E.

IN RECENT YEARS—that is, during the war—the fire protection interests have been confronted with many new forms of extra-hazardous risks, requiring other means of protection than water.

TYPICAL FIRE RISKS WHERE WATER PROTECTION IS INSUFFICIENT

Of these risks, the manufacture of dyes is perhaps the most prominent. Many of the coal-tar derivatives used in this industry are flammable liquids lighter than water. It is obvious that water would be useless for extinguishing fires started in such materials.

The paint industry is another business where the same peculiar hazards are encountered, while varnish manufacturing has even greater hazards than ordinary paints.

In varnish factories the gums and resins, together with the solvents used, are melted together in kettles over coal fires, and it is not uncommon for this to get so hot that the mixture boils over the sides and immediately ignites. In addition to this, the varnish is usually aged in large numbers of tanks 3 to 4 ft. in diameter, crowded together in floors of buildings, where a fire in one tank, caused either by a spark of static electricity igniting the fumes or from some external

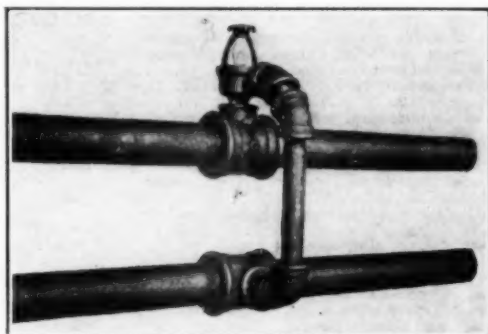


FIG. 1. FOAMITE SPRINKLER HEAD

source, would set fire to the whole room, with the result that hundreds of gallons of burning varnish would be spread over the floor.

In the rubber business solvents are used to make the rubber cement and for preparing the "friction" holding the rubber lining of hose to the cotton jackets, so that in nearly every rubber plant there is one room containing quantities of carbon bisulphide or other solvents for rubber, making an extremely bad hazard.

In linoleum factories we have the oxidizing room, where the linseed oil is treated.

In furniture factories it is becoming the general practice to varnish by dipping the article repeatedly in vats of varnish and drying the piece between successive coats. This means that in such plants there is risk that the whole factory may be set afire, in which case the use of the ordinary water sprinkler could accomplish nothing.

Nearly all the manufacturers of automobiles today adopt this practice for enameling fenders and other parts of the bodies. The parts are hung on a slow moving endless chain. The parts when clean and dry dip down into a bath of enamels, then move on, the excess enamel draining off, and pass through a heated

oven, the source of heat being steam coils or electricity. This cycle is repeated several times before they are removed in the finished condition.

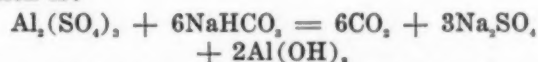
These vats of enamel are kept warm and, of course, the drying ovens are full of the fumes of the solvent being dried out of the enamel, so that a fire in one vat may ignite the whole series.

The above are merely a few of the most prominent hazards of the kind under discussion. It will be apparent that no matter how well a manufacturing plant may be otherwise protected against fire, such, for instance, as the well known automatic sprinkler system, hose stations, soda-and-acid extinguishers, the whole plant is menaced by these "powder magazines" in one part of the plant.

AUTOMATIC FIREFOAM SPRINKLER SYSTEM

Such risks must be protected by a medium which will exclude the air from the burning liquid in the manner which the well-known Firefoam system does in tanks of the large oil companies, and this is now possible by means of a special form of automatic Firefoam sprinkler system.

The system requires two solution tanks and two separate systems of piping, as the foam is produced by the reaction between an acid solution, aluminum sulphate, and a basic solution of sodium bicarbonate, to which the foaming ingredient known as Foamite is added. The reaction is:



The combination produces sodium sulphate, an inert salt, aluminum hydrate, a gelatinous material which stiffens the foam, and free carbon dioxide, which is held by the combined action of the gelatinous aluminum hydrate and the Foamite in the form of a mass of minute bubbles or foam.

This foam is projected on the burning object, completely covering it and excluding the air, while the bubbles, as they gradually break, liberate carbon dioxide, which inhibits combustion.

The foam produced is equal to eight times the combined volumes of the two solutions from which it was produced, so that 1 gal. of each solution will produce 16 gal. of fire-smothering foam. It will be seen that the foam is extremely light, having a specific gravity of approximately one-eighth that of water, and consequently is lighter than the lightest of coal-tar or petroleum products. It will, therefore, float on the surface of these, cutting off the air supply upon which the combustion depends, and will not sink down and float the liquids over the premises as will water.

The foam, being a mass of bubbles, should be created at the point when it is to be used; for, while quite tough and durable, it should be subjected to as little compression or agitation as possible, and it is not desirable to force the foam, after its creation, through lengths of pipe, around sharp corners or through small orifices.

SOLUTIONS MIXED AT SPRINKLER HEAD

The Foamite sprinkler head (Fig. 1), which is of the well-known Grinnell type, is therefore designed so that the two chemicals mix in the particular head or heads over the fire and are simultaneously released upon the fusing of the strut by the heat of the fire.

The two streams of chemical solutions then are thoroughly mixed by the peculiar construction of this head,

and the resulting foam showers down over the fire below.

The source of supply of solutions may be any variation of the standard approved sprinkler practice, such as gravity or pressure tanks, but there must be separate tanks and separate pipes, as the solutions must not mix except at the head.

Owing to the corrosive nature of the acid solution, the tank containing this must be either of wood or of special construction, or of lead-lined steel.

For the same reason the Firefoam automatic sprinkler system is preferably of the dry pipe type, to avoid the expense of lead-lined pipe throughout for the acid line.

The usual practice is to use the dry pipe system and ordinary piping in the building, the only lead-lined pipe being that at the tanks in constant contact with the acid solution.

For the same reason the system should be thoroughly washed out after use with water, and, where possible, the basic solution is washed out through the acid line

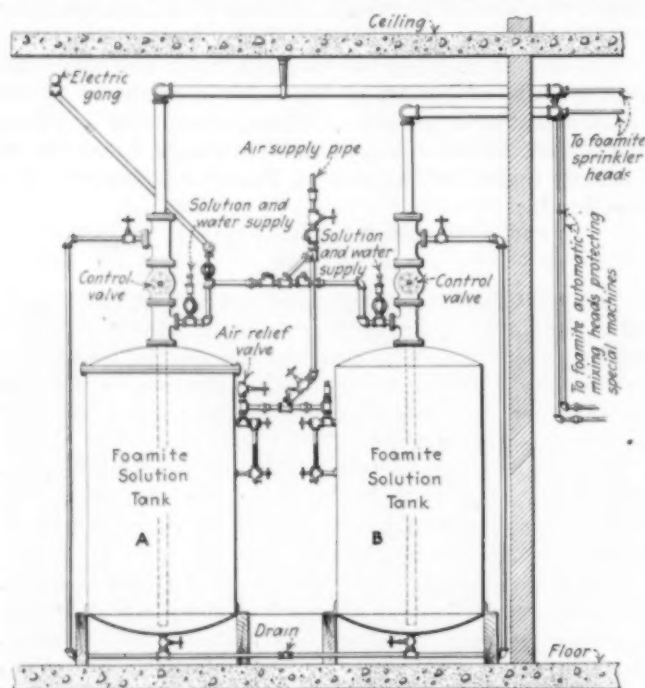


FIG. 2. DIAGRAM OF VALVELESS SYSTEM

by means of a cross-connection at the end of each pair of lines, so the basic solution remaining in the basic line will be washed into the acid line and neutralize any of the acid solution which might remain in the latter after both had been drained back to their respective solution tanks.

The ordinary dry pipe valve, lead-lined up to the seat, may be used for the acid line, and the ordinary dry pipe valve for the basic line.

Installations of any size permitted by the fire insurance interests may be installed by using the accelerator valve in particularly large systems.

For small systems what is known as the valveless system may be used, which in its simplest form is shown in Fig. 2.

The solution tanks are filled two-thirds full of the chemical solutions, and air pressure built up to the pressure required to deliver the solutions to the heads.

The same pressure will also be built up in the pipe lines through the check valves, which have a small ori-

fice through them. This compensates for any minor leaks in the air piping, but the orifices are so small that they will not compensate when a sprinkler head is released. When this occurs, the unbalanced pressure in the solution tanks forces the solution up and out of the sprinkler heads.

There are a number of other methods which may be used in addition to those described, and a careful survey of the conditions with all the engineering data is required to devise the proper installation for any conditions. It will be seen, however, that this new application of Firefoam offers a means not only of reducing these extra-hazardous risks to a point where they are no greater than those of an ordinary fire, but also, by eliminating these special hazards, of reducing the risk on the whole plant, so that the lowest rate should be obtained on the latter.

Foreign Trade of Germany in 1920

The Federal Statistical Bureau of the German Ministry of Economics furnishes an itemized statement of Germany's foreign trade during the twelve months of 1920. The figures do not include reparations deliveries under the terms of the Treaty of Versailles.

The itemization of Germany's foreign trade for 1920, presented in the *Monatliche Nachweise*, is given in the accompanying table:

Articles	Imports, Double Centners*	Exports, Double Centners
Agricultural, animal, and vegetable products, including foodstuffs.....	65,625,129	14,095,778
Animal and vegetable spinning materials and manufactures thereof, including human hair, prepared feathers, fans, and hats.....	871,597	782,698
Brooms, brushes and sieves.....	2,602	24,829
Caoutchouc goods.....	20,611	31,132
Chemical and pharmaceutical products, including dyes and dyestuffs.....	2,656,364	26,324,611
Clay goods.....	549,473	3,823,766
Glass and glassware.....	138,954	1,184,284
Goods prepared from bones, wood, cork, and other plant dissection.....	70,989	1,286,938
Leather and leather manufactures, including furs and goods made from animal waste.....	168,012	99,777
Machines, vehicles, and electrotechnical products.....	81,413	6,726,116
Metals:		
Coarse, and manufactures of.....	5,294,219	18,478,827
Precious, and manufactures of.....	163	2,530
Mineral and fossil raw materials, and mineral oils.....	111,398,942	118,479,877
Paper and pulp, and manufactures of.....	800,729	2,770,938
Stones and other minerals (excepting clay) and fossil material, manufactures of.....	236,292	3,184,214
Wax (prepared), paraffin, and related products, including soap, and other fatty substances, oils, and wax manufactures.....	411,890	81,991
Wickerwork and goods plaited from plants, excepting spinning fibers.....	10,337	46,312
All other articles.....	28,545	671,461
Total.....	188,366,261	198,096,079

*1 double centner = 220.46 lb.

Formula for Strength of Rope

At the Bureau of Standards laboratories tests have been made that have resulted in a formula quickly determining the strength of rope.

For three-strand regular lay manila rope from $\frac{1}{2}$ to $4\frac{1}{2}$ in. in diameter, the following computation will give the breaking load of the rope: The average breaking load in pounds equals 5,000 multiplied by the diameter of the rope in inches, multiplied by the diameter of the rope increased by 1.

This will give, of course, the average maximum weight that the rope will hold, but the working load that may be applied with proper safety and precaution would be considerably less than the load given by the formula.

Other data on rope are contained in the Bureau of Standards Technologic Paper 198, by A. H. Stang and L. R. Strickenberg, which has just been issued.

Superpower System for the Boston-Washington Region

THE United States Geological Survey has just published Professional Paper 123 (255 pages) embodying the report of W. S. Murray and others on the Superpower System for the region between Boston, Mass., and Washington, D. C.

Congress has appropriated during the fiscal year 1921 the sum of \$125,000 "For the survey of power production and distribution in the United States, including the study of methods for the further utilization of water power and the special investigation of the possible economy of fuel, labor and materials resulting from the use in the Boston-Washington industrial region of a comprehensive system for the generation and distribution of electricity to transportation lines and industries, and the preparation of reports thereon." An additional sum of \$26,000 was contributed by thirty-six corporations and individuals, representing utilities and industries in the superpower zone. The work was promptly organized and an engineering staff was selected by Mr. Murray, consulting engineer, of New York City, who was appointed by the Secretary of the Interior to head this engineering study. The investigation was begun on July 1, 1920, and completed within a year. Some of the principal facts brought out in the report are presented in the following paragraphs.

THE SUPERPOWER ZONE

The "superpower zone" may be described as lying between the thirty-ninth and forty-fourth parallels of latitude and extending from the coast approximately 150 miles inland, embracing parts of the States of Maine, New Hampshire, Vermont, New York, Pennsylvania, Delaware and Maryland and all of the States of Massachusetts, Rhode Island, Connecticut and New Jersey. Within this zone is concentrated one-fourth of the population of the United States, and within it are operated, most of them independently, 315 electric utilities, 18 railroads and 96,000 industrial plants.

The superpower zone has relatively small hydro-electric resources and maximum industrial-power requirements. Fortunately some of the best coal deposits in the country lie near this great industrial territory, and a prime economic purpose should be so to conjoin the hydro-electric supply of power to the steam-electric supply as to produce a maximum of energy for a minimum investment of capital and a minimum operating expense, and at the same time to conserve the rapidly disappearing cheap fuels of the Appalachian coal fields.

The superpower system comprehends also a plan of power production that includes the generation of electricity by steam at tidewater and on inland waters where a sufficient quantity of condensing water can be obtained, and also the utilization of all hydro-electric power that may be economically obtainable from rivers within the zone or within transmission distance of it. The electric power so generated will be co-ordinated through a system of inter-connected transmission lines, the potentials of which will be on the order of 220,000 and 110,000 volts.

PRESENT POWER PLANTS IN THE SUPERPOWER ZONE

Under the present independent operation of the electric utilities and the manufacturing industries in the superpower zone the existing power plants are numerous and small. The average capacity of the 558 elec-

tric-utility plants now in operation in the zone is 7,900 kw., and that of the steam-electric plants 10,000 kw., while the hydro-electric plants average only 2,800 kw. Out of the 96,000 industrial establishments in the superpower zone 76,000 use power, and each of these isolated plants averages about 350 hp. Under the superpower system, by contrast, the number of power stations required to supply the entire zone in 1930 will be only 273, of which 218 will belong to the existing electric utilities. The capacity of the base-load steam plants will range from 60,000 to 300,000 kw. In none of these plants will there be installed a turbo generator having a capacity of less than 30,000 kw.

LOCATION OF POWER STATIONS AND LOAD CENTERS

The new power stations and load centers will be so located with reference to the existing electric-utility plants that are to be incorporated in the system as to insure the maximum aggregate economy in power generation and transmission. A prime object to be attained in the superpower plan is the maximum economic utilization of existing generation and transmission equipment. In the early stages, while the superpower system is taking form, existing electric-utility capacity will predominate. Indeed, in 1930, as much as 31 per cent of the total superpower capacity will be contained in plants belonging to the present electric-utility companies.

The fundamental information required for the determination of the mechanical power-supply equipment and fuel used by all the industries necessarily had to be procured from the Bureau of the Census, if for no other reason because time would not have permitted its independent compilation. The analysis of this information showed that in 1919 the equivalent of 9,311,440,000 kw.-hr. was developed by prime movers operated by the industries themselves and that 3,338,800,000 kw.-hr. was purchased. It further shows that it would have been economical to shut down 4,008,200 hp. of prime movers and purchase energy to the amount of 5,623,800,000 kw.-hr., which would have made a total of 8,962,600,000 kw.-hr. purchased in 1919. The saving in coal thus effected would have been 13,502,100 tons—71 per cent of the coal used by the industries for producing power, or 25 per cent of all the coal used by the industries.

REDUCING COST BY INTERCONNECTING SYSTEMS

In general it has been found that industrial establishments which require 500 hp. or less can economically purchase energy. Only those that need more than 500 hp. and that have special requirements for heat can generate their own power economically, and even these should have central-station connections to take up irregularities of load. The efficiency of power production by isolated industrial plants is precluded from any considerable improvement by their necessarily small average capacity.

A careful study of the power requirement for industrial establishments in the superpower zone has been made and has shown that by 1930 an annual saving of \$190,000,000 can be made to the industries themselves above the fixed charges against an investment of \$185,000,000 for the motor equipment necessary to utilize the power.

Of great interest is the economic relation established between the joint use of steam and water power. It is shown that steam and water power can be so combined

as to yield annually \$69,550,000 on an increased investment of only \$44,838,000. Here is exemplified one of the prime advantages of superpower production, costs being reduced by means of the interconnecting system which permits the highest economy in steam-produced power together with the maximum use of water power.

HYDRO-ELECTRIC POWER

The construction of a hydro-electric plant is economically justified if it produces its power at a cost less than that of a steam-electric plant of the same capacity. With maximum development of water power, however, the hydro-electric energy available within the superpower zone will amount to less than 20 per cent of the total electric power required in 1930.

Of especial importance in determining the location and capacity of the new water-power plants for the zone is the economy attained by the development of rivers beyond their primary power. The principal rivers which can contribute water power to the superpower zone are the Potomac, Susquehanna, Delaware, Hudson and Connecticut. It is proposed to utilize power from these rivers in 1930 to the following extent:

River	Capacity, Kw.	Output (Millions of Kw.-Hr.)	Investment	Production Cost (Mills per Kw.-Hr.)
Potomac.....	200,000	950	\$22,000,000	3.36
Susquehanna.....	185,000	1,230	28,000,000	3.22
Delaware.....	350,000	1,250	51,500,000	5.95
Hudson.....	150,000	900	38,350,000	5.84
Connecticut.....	165,000	760	29,000,000	5.45

The water powers of Niagara and St. Lawrence rivers are within transmission distance of the superpower zone, but on account of the time required for construction on the St. Lawrence and of the treaty restrictions concerning the use of the water at Niagara Falls the power from these sources has not been considered available in the zone prior to 1930.

The reproduction cost of the 451,500 kw. of existing hydro-electric capacity within the zone is \$87,127,000. The new hydro-electric capacity which should be installed by 1930 will bring the total capacity up to 1,501,500 kw., of which the old plants will represent 30 per cent. In 1930 the total hydro-electric investment will be \$245,977,000, of which the old plants will represent 35 per cent.

RECOMMENDED PROCEDURE

The order in which the superpower steam-electric and hydro-electric power plants and transmission systems should be constructed must depend (1) on the present industrial demand for energy that cannot be satisfied because of the difficulties of the local electric utilities in financing extensions; and (2) on the future demand for energy that will result from the more economical generation of power under the superpower system. Many of the economies incident to superpower operation will be effected through the interconnection of existing plants and systems, and these economies should be increased as new power plants and interconnections are added.

By keeping in mind the two conditions, it is believed that the quickest return will be obtained by following in chronological sequence the order of procedure as follows:

1. The construction of a steam-electric plant near Pittston, Pa., to supply a part of its energy to the Anthracite division of the superpower zone and the remainder to the Metropolitan division, particularly New Jersey.

2. The construction of a steam-electric plant near Sunbury, Pa., to supply a part of its energy to the Anthracite division, a part to the Reading load center, and the remainder to Philadelphia.

3. The construction of hydro-electric plants on Delaware and Susquehanna rivers to supplement the steam plants indicated above.

4. The progressive development of the Hudson River projects to meet the growth of energy requirement at the Schenectady, Utica, Poughkeepsie and Pittsfield load centers.

5. The construction of a steam-electric plant near Boston to supply the Boston, Lowell and Newburyport load centers.

6. The construction of a steam-electric plant near New Haven to supply the New Haven, Bridgeport, Waterbury and Norwich load centers.

7. The partial construction of the first hydro-electric plant in the development of Potomac River as soon as the power demands of the Baltimore and Washington load centers require additional plant capacity.

Plant capacities are not stated above, as they cannot be finally determined except by further and more detailed study of local conditions combined with regional demands. The load growth at all the centers, however, will make it imperative to provide new plant capacity at an early date, so that the construction of additional plants must be started promptly after the plants that will yield the greatest return have been built.

ADVANTAGES OF SUPERPOWER ENERGY

The market for superpower energy will be furnished by the electric utilities, the industries and the railroads. The estimated requirement for energy supplied through the electric utilities for municipal, private, industrial and railroad purposes in 1930 is 31,000,000,000 kw.-hr. This energy could be supplied by a co-ordinated power system at an annual cost of \$239,000,000 less than by an unco-ordinated system such as is now in use. This amount represents the net saving after the necessary fixed charges on total capital expenditure have been deducted. The total investment in generating and transmission facilities for the superpower system will be \$1,109,564,000, of which \$416,346,000 will represent the value of existing facilities to be incorporated into the system.

A study of the 96,000 manufacturing establishments operating within the superpower zone shows that by 1930, through the maximum economical use of purchased electric energy, they can save \$190,000,000 annually above the fixed annual charges against a capital investment of \$185,000,000 to provide the motor equipment necessary to receive and use the necessary electric power.

The combined capital investment necessary for the electric utilities and the industries as of 1930 therefore amounts to \$1,294,564,000, and this total investment will yield annually above the fixed charges the sum of \$429,000,000, or 33 per cent on the amount of the investment.

Within the superpower zone there are 36,000 miles of railroad measured as single track—that is, including each track of main lines, yards and sidings. Of this total about 19,000 miles can be profitably electrified, so as to yield by 1930 an annual saving of \$81,000,000 as compared with the cost of operation by steam. The capital expenditure necessary to electrify the 19,000

miles would be \$570,000,000, and the average return upon the investment would therefore be 14.2 per cent.

Studies of the operations of each load center have shown that a large quantity of coal could have been saved had superpower facilities been available in 1919. On comparing the coal rates of power production in 1919 with those of the superpower system and applying the difference to the load that will exist in 1930 we find that the coal saved annually under the superpower system may be estimated as follows:

	Short Tons
Electric utilities.....	19,149,000
Heavy-traction railroads.....	10,210,000
Manufacturing industries.....	20,625,000
Total.....	49,984,000

COAL SAVING BY CHEMICAL AND METALLURGICAL INDUSTRIES IN SUPERPOWER ZONE

Of the total quantity of coal to be saved by the superpower system, chemical and metallurgical industries would contribute the following savings:

Industry	Coal Saved in Short Tons	Industry	Coal Saved in Short Tons
Dyeing and finishing.....	34,500	Gas, illuminating and heating.....	163,000
Steel works and rolling mills	1,035,000	Petroleum refining.....	49,000
All other iron and steel products.....	1,124,400	All other chemicals.....	586,000
Tanning, currying and finishing of leather.....	10,000	Cement.....	94,000
Paper and wood pulp.....	390,000	Clay products.....	97,400
Coke, except gas-house coke	51,000	Glass products.....	27,500
Explosives.....	52,000	Metals, non-ferrous.....	199,000
		Metal products, non-ferrous	112,000
		Total.....	4,024,800

Synopsis of Recent Chemical & Metallurgical Literature

Alcoholic Fermentation as a Source of Glycerine.—In 1780 Scheele obtained glycerine by the saponification of fats with lead oxide. In 1823 Chevreul proved that glycerine is an integral part of fats in the form of an ester of the fatty acids. This has been confirmed by Pelouze and since then glycerine has been prepared commercially by saponification of fats in soap plants. During the war, due to the scarcity of fats, researches were started to prepare glycerine synthetically or by fermentation. As early as 1873 Friedel and Silva succeeded in preparing glycerine synthetically, but up to now the process has not been an industrial success. The fermentation method at first used by Pasteur has been more successful, and Dr. K. Schweizer gives in the August, 1921, issue of *Chimie et Industrie* a lengthy description of the industrial preparation of glycerine by alcoholic fermentation.

After reviewing the work of Pasteur, Laborde, Ehrlich, Rossi, Neuberg and Kerb, he outlines the facts and hypotheses concerning the intermediate products formed during alcoholic fermentation and then describes the changes in normal alcoholic fermentation which are necessary for the manufacture of glycerine as the main product. Among the methods used for the realization of these changes he gives the following:

Reduction of Trioses. Since it is known that glycerine can be obtained by the reduction of glyceric aldehyde and dioxycetone and since these substances are supposed to be formed as intermediate products during the conversion of sugar into alcohol, it seemed logical to expect that the addition of a reducing agent during fermentation would increase the yield of glycerine. The greatest practical difficulty was to find a yeast which would function in the presence of the large quantities of salts constituting the reducing agent.

However, by the use of a yeast prepared from molasses, and a great excess of sodium sulphite, it was possible to obtain 21.3 g. glycerine from 100 g. sugar.

Change of the Reaction of the Fermentation Medium. This is best realized by introducing given quantities of sodium carbonate in the fermentation medium shortly after fermentation started. Twenty to 25 kg. of glycerine can thus be obtained per 100 kg. of sugar.

Blocking the Formation of Acetaldehyde During Fermentation. This is best realized by using sodium sulphite, which acts not only as an alkaline reagent but also as an antiseptic for the harmful bacterias resulting from the fermentation in alkaline medium. About 23 kg. of glycerine is obtained per 100 kg. of sugar.

The author then describes the method used for the extraction and purification of the formed glycerine. He concludes by suggesting that instead of starting with sugars, which are expensive, there will soon be a possibility of preparing glycerine by using hydrolyzed sawdust and waste sulphite liquor from paper mills.

Hardening of Tool Steel.—Shipley N. Brayshaw presented a paper recently before the Sheffield Association of Metallurgists and Metallurgical Chemists, and abstracted in *Iron and Coal Trades Review*, upon an ordinary carbon tool steel containing about 0.8 per cent of tungsten and about 0.2 per cent of chromium, with a change point at 738 deg. The work was mainly for the purpose of determining the effect of various heat-treatments by means of test-bars and test-cutters. Some of the cutters were badly broken; others were fairly sound; even of the sound ones some were good and some were bad so far as their strength was concerned. Yet when each group was examined it was shown that there was a clear relation between the previous heat-treatment and the behavior on hardening. The results from the whole series of 102 cutters were reasonably consistent with scarcely half a dozen exceptions; furthermore, the results were in general accord with those obtained from the test-bars before and after hardening.

It was found that for the steel in question there was a range of temperature of somewhere about 715 to 725 deg., within which with prolonged soaking the steel reached a condition which was remarkably favorable to satisfactory hardening, as was shown by the non-occurrence of hardening cracks and the fact that taps and screw gages could be hardened without change of pitch.

Mr. Brayshaw made a proposal for a standard hardening test for the purpose of ascertaining the degree of liability of a given steel to crack in hardening. He believed that the hardening of steel could be brought completely under control provided it were reasonably sound and not objectionable in analysis. Such a simple test would show whether the steel was liable to hardening cracks or not, and the degree of liability would be indicated.

Separation of Lime From Dolomite.—H. G. Schurecht, in the July *Journal of the American Ceramic Society*, publishes an exhaustive study of "The Separation of Lime From Dolomite." Magnesium carbonate in dolomite is decomposed by calcining for 1 hour at 800 deg. C. Calcium carbonate is not completely decomposed until after calcination at 960-1,040 deg. C. for 1 hour.

By adding sufficient sulphuric acid to milk of dolomite to react with the lime present, a bulky precipitate of magnesium hydroxide is formed which may be partly separated from the finer calcium sulphate by screening through a 120-mesh sieve. The residue on the screen contains about 68.3 per cent magnesium oxide and represents about 50 per cent of the original CaMgO. The best results by flotation were obtained by removing the fine material from the raw dolomite and then calcining at 920 deg. C. Wood creosote flotation oil No. 400 was found best suited for this separation. The concentrates removed by flotation, however, represent only 25 per cent of the dolomite originally treated. By leaching and screening treatment it is possible to obtain a product containing about 80 per cent MgO. This is superior to the Canadian magnesite in MgO content. By an elutriation treatment it is possible to obtain a residue containing over 85 per cent MgO and representing about 30 per cent of the original dolomite.

Current Events

in the Chemical and Metallurgical Industries

Tariff to the Fore Again

With the tax bill practically out of the way, the Senate is concentrating its interest on tariff matters. The extent to which the chemical industries are to receive protection practically will be decided during the next few weeks. The thing which is militating most against high rates on chemicals is an impression on Capitol Hill that the chemical industries have been unusually prosperous under existing rates of duty. There is also an impression that the banking interests have gained the upper hand in many chemical activities and that there is a tendency to eliminate research and experimentation in the interest of greater profits. One of the principal reasons which influenced the House committee to recommend unusual measures for the protection of the chemical industry was the very evident need of incurring large expense in research so that the new American industries might compete successfully with the long-established chemical concerns in other countries. There is an idea that many of the former leaders in the industry who built up pretentious activities, despite the lack of protection, and who had the vision to incur large expense in experimentation study, are being crowded aside by interests who are more concerned in quick profits than in the permanency of the industry.

Fertilizer Freight Rates Discussed

A reduction of 25 per cent in the freight rate on fertilizer was urged at a hearing in Washington Nov. 2 before the traffic executives of the Southern railroads. J. W. White of Atlanta, chairman of the traffic committee of the National Fertilizer Association, and John I. Tierney, Washington representative of that organization, appeared in behalf of the fertilizer industry. They contended that the fertilizer industry had reduced its prices to the point of actual loss in its effort to be helpful in the general return to more normal prices. The fertilizer used in 1921 was 59 per cent of the amount used in 1920. One of the principal causes for this decline in fertilizer use was held to be freight rates, which have contributed nothing to the liquidating process. As a result of the reduced use of fertilizer, the cotton crop is 7,000,000 bales less than would have been the case had the fields been properly fertilized, the railroad executives were told.

National Research Council Publication on Research Chemicals

Timely information with regard to research chemicals is contained in a publication being distributed gratis by the National Research Council. The pamphlet contains a list of manufacturers, as well as an alphabetical list of the several thousand of the rarer chemicals. The pamphlet also contains a list of biological stains and indicators and another list of hydrogen ion indicators. The work follows the lines of "British Research Chemicals," published by the Association of British Chemical Manufacturers.

Standardization of Paving Brick

Elimination of excess varieties and styles in paving brick is to be considered at a meeting Nov. 15 in Washington under the auspices of the Secretary of Commerce. The meeting is to be open to all interested. A preliminary survey of the situation is being made by a committee of paving brick manufacturers and a report will be submitted setting forth the facts as to the volume of the manufacture in the various sizes and styles of bricks now in use.

Chamber of Commerce Establishes Natural Resources Department

Half of the difficulties of the natural resource industries would disappear if the public were well educated in their problems. This is the opinion of W. DuB. Brookings, the head of the Natural Resources Production Department of the Chamber of Commerce of the United States. This department is preparing a very active program in an effort to render constructive service to the raw material industries. In that connection it was pointed out that this work is supplementary to that of the various trade associations. It is believed, however, that this nation-wide organization of business men can render great assistance to the industries and to the public by conducting a campaign of education intended to enlighten the public on the vital problems of natural resource activities.

The organization of the natural resources department is just being perfected. An advisory committee has been named of which C. S. Keith, the president of the Central Coal & Coke Co. of Kansas City, is chairman. The other members of the advisory committee are: J. H. Ross, president, Exchange Supply Co., Winter Haven, Fla.; J. E. Spurr, Editor, *Engineering and Mining Journal*, New York; Christy Payne, president, Peoples & Hope Natural Gas Cos., New York; E. T. Meredith, former Secretary of Agriculture, Des Moines, Iowa; Sidney J. Jennings, vice-president, United States Smelting, Mining & Refining Co., Boston, Mass.; R. V. Norris, mining engineer, Wilkes-Barre, Pa.; Van H. Manning, American Petroleum Institute, New York, and William H. Davis, president, Midcontinent Oil & Gas Association, Bartlesville, Okla.

It is the opinion of Mr. Brookings that nothing is of more importance in this day with its tendencies toward federal regulation of business than to obtain for the natural resources industries a high degree of public confidence. This, he believes, can be obtained if the public knows the real facts in regard to these industries.

American Field Service Fellowships for French Universities

The Society for American Field Service Fellowships for French Universities will offer for open competition among graduates of American colleges and other suitably qualified candidates a number of fellowships, not to exceed twenty-five, for the purpose of encouraging advanced study and research in French universities during 1922-23. The fellowships, of the annual value of \$200 and 10,000 francs, are granted for one year and are renewable for a second year. They may be awarded in thirty-one fields of study, including chemistry, engineering, geology, mathematics, physics.

Fellows will be required to sail to France not later than July 1 of the year in which the award is made, to matriculate in a French university for the following session, and to pursue studies in the field of science designated in their awards.

Applications should reach the secretary of the society not later than Jan. 1, 1922. Application blanks and full information as to qualifications, etc., may be obtained from the secretary, Dr. I. L. Kandel, 522 Fifth Ave., New York City.

Sterling Chemical Laboratory, Yale University

With the awarding of the contract for the erection of the new chemical laboratory at Yale University, New Haven, Conn., to the Thompson-Starrett Co., 49 Wall St., New York; it is proposed to commence work immediately on the structure. The new laboratory, to be known as the Sterling Chemical Laboratory, is estimated to cost \$2,000,000.

Congress of Industrial Chemistry at Paris

The first Congress of Industrial Chemistry was opened on Monday, Oct. 10, at the National Arts and Crafts Conservatoire, M. Dior, the Minister of Commerce, presiding. Many distinguished scientists and chemical experts attended, including Mme. Curie and Sir William Pope. Dr. Frederick Cottrell and Dr. Mackall represented the United States. Paul Kestner, president of the Société de Chimie Industrielle, opened the proceedings with an account of the work of the society and outlined the subjects which would come within the range of the conference.

Sir William Pope lectured on the future of organic chemistry, with special reference to the advantages which France and Britain might derive from their tropical possessions. He was presented by M. Dior at the conclusion of his lecture with the gold medal of the French Society.

Great interest was taken in the public lecture given at the Sorbonne by Georges Claude on his method of obtaining synthetic ammonia. The lecture was illustrated both by lantern slides and experiments, M. Claude actually producing synthetic ammonia in the hall. This manufacture, he said, as carried out at the Montereau works, where pressures up to 1,000 atmospheres are used, is incomparably less dangerous than might be supposed, since by reason of the high pressures employed the parts of the apparatus used in the Claude process are so small that an explosion, as proved by experience, does no damage. Moreover, the ammonium salt (ammonium chloride) produced by the French methods is non-explosive, so no disasters similar to that of Oppau need be feared.

Lectures were also given by M. Matignon, professor at the Collège de France, on the state and development of the nitrogen industries and by M. Gall on the French cyanamide industry.

Henri Le Chatelier, member of the Institute of France, lecturing on chemical analysis, emphasized the necessity of supplementing laboratory experiments by experiments in the industrial field and pleaded for an improved system of teaching chemical analysis and for some standardization of methods of analysis.

An exhibition of applied chemistry was held in connection with the conference.

Plants Resuming Operations Growing in Number

Glassware.—The F. C. Wheaton Co., Millville, N. J., manufacturer of druggists' glass specialties, has resumed operations at its plant, effective Oct. 31, placing its furnace, the largest in south Jersey, in service.

The Potomac Glass Co., Cumberland, Md., has resumed production with a full operating force, totaling about 250 workers, following a shut-down since July.

The Hazel-Atlas Glass Co., Wheeling, W. Va., manufacturer of fruit jars, etc., has placed an additional tank in service at its Clarksburg, W. Va., works, effective Oct. 31, giving employment to about 200 additional employees and bringing operations up to a point of approximately 28 per cent of the full quota of 850 workers that are employed in normal times.

The Whitall-Tatum Co., Millville, N. J., manufacturer of druggists' glassware, has placed a new amber glass tank in operation at its Glasstown works, giving employment to additional workers. The lamp department at the works has been started up at full capacity.

The American Window Glass Co., Belle Vernon, Pa., has resumed operations at its local plant, following a six-months shut-down. It is said that orders on hand insure capacity production for some months to come.

Paper.—The International Paper Co., 30 Broad St., has increased production at its mills to about 700 tons of paper per day, or close to 60 per cent of capacity. A total of eleven mills are now operating and it is planned to resume at other mills at an early date.

The Dryden Pulp & Paper Co., Montreal, Que., is now operating at capacity, with the sulphite mill producing about 70 tons of material a day, the kraft paper mill about 13 tons daily, and the paper board mill running at close to capacity.

Rubber.—The Mason Tire & Rubber Co., Kent, Ohio, is

operating at full capacity, with three shifts. The output totals about 11,000 casings a week.

The Boston Woven Hose & Rubber Co., Boston, Mass., is now operating at close to 70 per cent of normal, with the hose-manufacturing department, comprising about 20 per cent of the total output at the works, producing at 75 per cent of normal. The tape, heel, tube and matting departments are increasing their operating schedules. Effective Nov. 1, wages at the mill have been reduced 5 to 15 per cent, with the average labor reduction at 10 per cent.

Oil.—The Sinclair Consolidated Oil Corporation, 45 Nassau St., New York, operating refineries in Indiana, Kansas and Oklahoma, will place all plants on a capacity basis of production at once.

Coke.—The H. C. Frick Coke Co., a subsidiary of the United States Steel Corporation, has placed 350 coke ovens in blast at its plants at Calumet, Southwest and Hostetter, Pa., closely following the resumption of operations at the Continental No. 1 and York Run plants of the company, totaling 600 ovens, on Oct. 24. This total of 950 ovens will give employment to over 1,200 men. The ovens have been banked since last spring. It is planned to place 300 ovens at the Brownsville, Pa., works in operation at an early date.

Steel.—The Superior Sheet Steel Co., Canton, Ohio, is operating at full capacity, with eight mills in service.

The Cumberland Steel Co., Cumberland, Md., has agreed with operatives at the plant for production on a two-shift, full-time basis, each shift to work three 10-hour days a week. The men have accepted a wage reduction of 10 per cent.

The Tyler Tube & Pipe Co., Washington, Pa., has resumed operations at its plant. Orders on hand are said to insure continuous production throughout the fall and winter.

Iron.—The Reading Iron Co. is arranging for the immediate resumption of its Keystone blast furnace, Reading, Pa., with a weekly output totaling 2,000 tons.

Chemical.—The Solvay Process Co., Syracuse, N. Y., is now operating at close to normal pre-war production at its Solvay works, manufacturing soda ash and its derivatives. Early in the summer the plants were on a 40 per cent capacity basis.

Lower Freight Rates Sought for Pottery Products

Representative pottery interests at Trenton, N. J., and vicinity are formulating plans to bring about an early readjustment and lowering of freight rates on commodities entering into the manufacture of sanitary pottery, including clay, feldspar, flint, etc. It is held that these materials are now defraying more than their just proportion of the transportation burden of the country and that a reduction in rates will stimulate greatly business in the sanitary ware line. A committee has been appointed to compile data and carry out the details of the movement. M. D. Warren, traffic manager of the Chamber of Commerce, Trenton, will act as chairman of the committee; other members include: Charles Brian, general manager of the Paper Makers' Chemical Co., Easton, Pa.; George Dyer, representing the Sanitary Potters' Association, Trenton; John Manor, Golding Sons' Co., East Liverpool, Ohio; A. C. Hoffman, Trenton Potteries Co., Trenton; L. L. Lee, Star Porcelain Co., Trenton; F. W. Walker, secretary, Beaver Falls Art Tile Co., Beaver Falls, Pa.; and Charles Donnelly, United States Potters' Association, Pittsburgh, Pa.

A.S.M.E. Meeting to Stress Elimination of Industrial Waste

Elimination of industrial waste will be stressed at the annual meeting of the American Society of Mechanical Engineers to be held in New York City, Dec. 5 to 9. The report of the Committee on Elimination of Waste in Industry of the American Engineering Council will provide the basis for the discussion, which will emphasize the engineering phases of the waste problem. The A.S.M.E., in arranging its annual meeting program, follows the recommendations of the committee that each technical society give intensive treatment to the report.

Personal

ALLEN ABRAMS has resigned as research associate from the research laboratory of applied chemistry at the Massachusetts Institute of Technology to become chief chemist for the Cornell Wood Products Co., Cornell, Wis.

Dr. CHARLES BASKERVILLE, College of the City of New York, gave an interesting address recently on the subject of chemical research, before a joint meeting of the Rhode Island Branch of the American Chemical Society and the Providence Engineering Society, at Brown University, Providence, R. I.

Dr. CHARLES H. HERTY has resigned as editor of the *Journal of Industrial and Engineering Chemistry* of the American Chemical Society to accept the presidency of the newly organized Synthetic Organic Chemical Manufacturers Association.

ALBERT HIRSCH has been appointed general sales manager of the Atriken Chemical Works, New Brunswick, N. J.

GEORGE E. HOFFMAN of the Trenton Potteries Co., Trenton, N. J., gave an interesting address on the subject of "Fine Pottery Manufacture" before the members of the Rotary Club, Allentown, Pa., at their noon-day meeting, Oct. 21.

JOHN F. MILLER of Pittsburgh, vice-president of the Westinghouse Air Brake Co., Pittsburgh, has been elected an alumni trustee of the College of Wooster, Wooster, Ohio, filling an unexpired term in the class of 1922. Mr. Miller graduated from the college in 1881.

WILLIAM WHISTLER MILLS, for five years assistant chief chemist of the Pittsburgh Crucible Steel Co. at its Midland, Pa., works, has been added to the faculty of the College of Wooster, Wooster, Ohio, as instructor in chemistry. Mr. Mills resigned from the Pittsburgh Crucible Steel Co. in 1919 to take up graduate work at Ohio State University, Columbus, Ohio, which he completed last June with the degree of Master of Science.

OLIVER C. RALSTON has been promoted from the position of superintendent of the Mining Experiment Station of the Bureau of Mines, Seattle, Wash., to assistant chief metallurgist with headquarters at Berkeley, Cal. He will also act as superintendent of the Pacific Experiment Station of the Bureau of Mines.

EDWIN R. THEIS, formerly chemist for the American Leather Co., Cincinnati, Ohio, has joined the staff of the department of leather research, College of Engineering and Commerce, University of Cincinnati, as research chemist.

The members of the technical staff of the American delegation to the Conference on the Limitation of Armament who were selected for their industrial and scientific knowledge are: Dr. Edgar F. Smith, president of the American Chemical Society; General C. C. Williams, Chief of Ordnance; General Amos A. Fries, Chief, Chemical Warfare Service; General George O. Squier, Chief, Signal Corps; William S. Culbertson, United States Tariff Commission; Dr. S. W. Stratton, Director, Bureau of Standards; J. H. Dellinger, Chief, Radio Investigations, Bureau of Standards; L. W. Austin, Radio Specialist, Navy Department. The other members of the technical staff are specialists in international law, international relations, or in army and navy operations.

Obituary

JOHN BOYD DUNLOP, Dublin, Ireland, known as the inventor of the pneumatic rubber tire, died on Oct. 24. He was eighty-one years old.

WILLIAM H. PRICE, secretary of Griffith & Turner, Baltimore, Md., fertilizer manufacturers, died recently at the age of sixty-six years.

Current Market Reports

The Chemical and Allied Industrial Markets

NEW YORK, Nov. 7, 1921.

Chemical activity continued to show increased signs of improvement and conditions in most directions were of a decidedly favorable character. The discontinuance of the proposed railroad strike did not have a bad effect on the demand for the more important commodities.

Buyers are more eager to anticipate their standing contracts and are covering requirements a month or two in advance. This condition was more pronounced last week than at any time during the year. Consumers that have accustomed themselves to small quantity buying have again been picking up large quantities of odd resale material from the spot market and the tendency of values has remained quite firm throughout the list.

Heavy importations of chemicals were noted during the week. These undoubtedly were shipments ordered a month or two ago and had no disastrous effect on spot quotations, as the bulk of this material is going directly to various consuming interests. Domestic producers have found it extremely difficult to keep up with the increasing demand, and efforts are being made to expand operations as much as possible.

Among the outstanding features of the week was the sudden rise of barium chloride. Prussiate of soda, cyanide of soda and caustic potash were items that attracted considerable attention from large consumers and the market has shown a gradual advance during the entire week. Prussiate of soda and barium chloride closed higher for shipment from abroad. Solid caustic soda and soda ash remained steady, with a tendency to advance. Oxalic acid still feels the pinch of keen competition existing among producers, and quotations were lower at the close. Bichromate of soda has ruled steady, with orders reported in larger volume. Consumers of muriate of potash have shown more interest at the recently reduced figures. Bleaching powder has also shown a regular steady outlet, although large quantities were recently imported from Germany.

CHEMICALS

Spot prices for imported 88-92 per cent caustic potash were a trifle firmer during the latter part of the week. Importations have been quite heavy, but consumers seem to be constantly in the market for additional quantities. While several sellers quoted the market at 6½c. per lb., the majority of holders named 6¼c. as their lowest figure. Shipment material was obtainable at 5¾c. per lb. Importers of calcined carbonate of potash, 80-85 per cent, quote 4¼c. per lb. for spot material. There are not as many offerings around the market as were noted a week ago and it is understood that some large sellers are very low on supplies. The 85-90 per cent test is quoted at 4¾c. per lb., while the 99 per cent U.S.P. is quoted at 15c. per lb. Foreign powdered chlorate of potash is offered for shipment at 5¼c. per lb. c.i.f. New York. Some sellers demanded as high as 5¾c. The spot market is somewhat unsettled on imported material, with sellers asking 6¼@7¼c. per lb. for the powdered and 8c. for the crystals. Manufacturers of domestic chlorate quote the market unchanged at 12c. per lb. f.o.b. works. Importers offered muriate of potash on the basis of \$37@37.50 per ton of 80 per cent KCl, c.i.f., New York. Buyers are showing a keener interest in the new prices and considerable business has been reported. Yellow prussiate of potash is moving in a small way at 20¼c. per lb. The general quotation heard among leading factors is 20¼@21¼c. per lb., depending upon quantity. The red variety is inactive and sellers quote the market at 28c. per lb.

There has been no departure from the upward tendency of yellow prussiate of soda during the past week. Buyers are eager to pay higher prices for spot material, but offerings are very scarce. Sales at the close were reported at 14¾c. per lb. In some places as high as 15c. was named for spot ma-

terial. Shipments were quoted at 14½c. per lb. for November-December. *Bichromate of soda* sold at 8c. per lb. during the beginning of the week and was fractionally higher at the close. A carload lot was reported sold at 7½c., but this was an inside transaction and did not represent the general range. Quotations were around 8½c. per lb. for standard brand goods. The demand is showing a moderate improvement with consumers more eager to follow the market activity. Sales of solid *caustic soda* have been made at \$4.10@4.20 per 100 lb. for standard material. A good inquiry was experienced for less than carload quantities. Producers have received numerous orders for large lots, but claim to be entirely sold out for prompt shipment. Buyers of *amyl acetate* are covering actual requirements in the market, but are not inclined to extend commitments at the present time. Producers quote the market for commercial at \$2.40@2.70 per gal., the price varying according to quantity and sellers.

Dealers of crude *fusel oil* quote the market at \$1.50@1.60 per gal. The imported material has sold at about the same figures as the domestic, although an occasional stray lot has been found at a concession. It is stated that prices abroad are higher than those prevailing in the open market. The refined grade is quoted by producers at \$2.60@3 per gal. Odd lots have been sold through dealers down to \$2.40 per gal., but in most instances, this material was not up to specifications. There was some improvement noted in the call for *arsenic*, and prices ranged from 6@6½c. per lb. for the white, powdered material. Some sellers of *nitrite of soda* were fractionally higher in their views and quoted the spot market at 7@7½c. per lb. Buyers, in general, were interested only in small quantities and were not eager to pay over 6½c. per lb. Closing prices for domestic *oxalic acid* at the works were somewhat lower and producers were quoting 12½c. per lb. Dealers reported sales ex-store at 13½@14c. per lb. The market is still feeling the influence of strong competition from first-hand interests.

COAL-TAR PRODUCTS

Reports from various steel factories of more pronounced activity put a brighter aspect on existing conditions for *benzene* and consumers feel more reassured about supplies. Coke-oven operations showed another gain, but this will not be reflected in the *benzene* market for at least another month. The spot market was practically bare of supplies, with quotations on odd lots heard at 40c. per gal. The intermediate market is showing decidedly improved signs of activity owing to the improved condition of the dye field and sales are more numerous in various quarters. The demand for *cresylic acid* is not very active, but the market seems to be holding its own at 65c. per gal. for the 95 per cent and 70c. for the 97-99 per cent. A round lot sale of the 95 per cent was reported at slightly under the quoted figure, but most sellers are adhering to the regular price. Activity in *naphthalene flakes* continued to a moderate extent, but the balls were somewhat dormant. Prime white flakes sold at 6½@7½c. per lb. Makers ask up to 8½c. per lb., but most business is going to jobbers at the lower figures. Buying in *phenol* for domestic consumption increased to a considerable degree and some large-quantity sales were made at 9½c. per lb. Odd lots at lower prices were occasionally offered around the market, but the quality is known to be of an inferior grade. Official Government resellers ask 12c. per lb. Selling in *para-phenylenediamine* has been fairly active at \$1.70@1.75 per lb. Inquiries at the close of the week were being recorded in good volume. Makers of *dimethylaniline* ask 45c. per lb. and upward. Resale stocks are practically unheard of around the market and first hands are the controlling influence on prices. Sales of *aniline oil* at 18c. per lb. were made in several directions during the week. The market seemed to be strengthening up somewhat and sellers are maintaining prices. Stocks of *beta-naphthol* are still quite heavy and no real snap to trading has been witnessed on this commodity in the past few months. Makers quote down to 34c. per lb., but according to various rumors have placed business well under the resale price of 32c. per lb. Prices of *H acid* in some directions were under the quotation of \$1.10 per lb. which prevailed generally.

The Chicago Market

CHICAGO, Nov. 4, 1921.

Viewing world markets over the last century and a half in relation to present commodity prices, it is noted we are on the down grade of a major commodity price cycle covering a 40- to 50-year period similar to the condition following the Napoleonic wars and the Civil War. Looking at the minor 3- to 5-year cycle, however, commodity prices show a straight precipitous drop beginning in July of last year and reaching a bottom near the middle of 1921. In other words, the curve of average commodity prices has not only been checked but actually moved upward. Chemicals, being essential raw materials of basic industries, follow very closely the average price of other commodities and vary with the industrial movements. It may be safely predicted that regardless of the possible lower prices of chemicals 10 years from now the immediate trend will be upward.

This trend is clearly shown by Chicago prices during the past fortnight. Stocks on hand are lighter, and while prices on the average have not risen to any great extent they remain very firm at present levels. Furthermore a good volume of business is enjoyed by most firms. Speculators are beginning to accumulate stocks with expectation of higher figures. Clearing of the skies on the railroad situation is removing the cause for immediate haste in purchasing. The next large movement should be upward regardless of pessimistic opinions which exist in some quarters.

INDUSTRIAL CHEMICALS

Caustic soda is very firm. Supplies are nearly depleted and prices are 4½c. for the ground 76 per cent and 4½c. for the solid. *Soda ash* is moving well, with firm price at \$2.60 per 100 lb. for material in coopeage. *Potash alum* is also in good demand, with a price of 5½c. per lb. for the lump and 6½c. for the powdered. *Sal ammoniac* remains quiet, with supplies available at 7½@7¾c. per lb. for the white granular 98-100 per cent. *Carbon tetrachloride* is in brisk demand and 10½c. per lb. the lowest figure quoted. *Formaldehyde* is still quiet, with 12c. per lb. as the prevailing figure and a possibility of some shading. *Glycerine* remains unmoved in price and without apparent demand. Refiners are asking 14½@14¾c. per lb. for the large drums.

LIST MOSTLY UNCHANGED

The rest of the list remains about as usual. *Caustic potash* continues firm and unchanged in price, with supplies available at 6½c. per lb. for the 88-92 per cent grade. *Potassium bichromate* is quoted at 13@13½c. per lb. and the *soda* at 9½c. for single casks. A decline of 2c. per lb. was noted in some quarters on *potassium permanganate*, and U.S.P. crystals of foreign origin are now available at 21c. for small lots. *Bicarbonate of soda* is offered at \$2.60 per 100 lb. for single barrels. *Sodium fluoride* is not so active, but prices are unchanged at 11@12c. per lb., according to quantity. *Zinc sulphate* is quiet at 3½c. per lb. for the tech. cryst. in single barrel lots.

ACIDS

Acid prices remain as quoted in last letter with nominal demand. Supplies are plentiful and are said to be moving well. *Acetic acid* is firm with supplies of the 28 per cent available at \$2.65@2.75 per 100 lb. and glacial at \$10.25@10.75. *Oxalic acid* is in fair demand at 17c. per lb. *Citric* and *tartaric acids* are very quiet with domestic makers apparently in control of the market. *Hydrochloric acid* is quiet and unchanged as to price.

VEGETABLE OILS

Linseed oil is moving in a fair way with no large transactions noted. The boiled oil is offered at an increased price of 76c. per gal. and the raw at 74c.

NAVAL STORES

Turpentine is in a firm position, according to a prominent factor, and higher prices can be expected. This material was offered today at 86½c. per gal. for small quantities in drums.

The Iron and Steel Market

PITTSBURGH, Nov. 4, 1921.

The tapering off in demand for steel products generally has now developed a decidedly quiet market. Buying has not ceased, but it is materially decreased in volume, and it lacks snap entirely. While various causes are assigned for the dullness, including in particular the alleged prospect that freight rates will be reduced in the near future, the more rational view seems to be that the dullness is a reflection of the season of the year. The iron and steel market is normally dull in December and January, unless it has previously acquired great momentum, and in a generally dull period the seasonal dullness is likely to begin especially early.

It is obvious that existing ideas or impressions as to the state of business generally and of the prospects are rather vague. "Business" is commonly spoken of as a homogeneity, which it is not. The total volume of business, measured by bank clearings, bank debits, freight ton-mileage on the railroads, and similar general indices, is really fairly large. The character of the activity, however, is not such as to produce a large demand for steel. In what is called by the very general term "building" there is a rather high stage of activity, but the building is chiefly of garages and dwelling houses, which do not require much steel. The same amount of money invested in power plants, factories and skyscrapers would produce a much larger tonnage of steel demand. Again, the railroads are receiving and spending a great deal of money, but the outgo is chiefly against pay-rolls, not against rails, bridges, buildings, rolling stock and other improvements.

STEEL PRICES

The American Steel & Wire Co. (Steel Corporation) has been soliciting contracts from regular customers on the ground that a second price advance, following that of Sept. 12, is to be made, the September advance having been to 2.60c. for plain wire and \$2.90 for nails. The Youngstown Sheet & Tube Co., which alone among the important independents did not advance its prices in September, has this week made the advance. By other independents there has been some selling lately at the old prices, and it is not certain that a second advance can be made generally effective.

In attempting a second step in advancing prices on sheets the market has slipped a trifle on the first step. Three weeks ago independents began formally announcing a second advance of \$5 a ton, following that in September, which raised black sheets from 2.75c. to 3c., but instead of the market becoming established at 3.25c. sales have been made in the past week at less than 3c., and even 2.75c., the minimum of the market this year, has been quoted in some isolated cases.

In bars, shapes and plates there is a more competitive market than a few weeks ago, in that some mills, formerly committed to slightly advanced prices, have receded from that position and are meeting competition when the tonnage involved is important. Prices generally are in the neighborhood of 1.60c. for bars and shapes and 1.55c. for plates.

Tin plate prices have continued unsettled and may become still more unsettled. The McKeesport Tin Plate Co., with a 44-mill plant, has made an agreement with its tonnage men whereby the men accept a 20 per cent wage reduction and the company guarantees full operation of the plant to Jan. 1.

PIG IRON AND COKE

The pig-iron market continues very dull, expectations recently entertained of an improvement being wholly disappointed. In some quarters the lack of buying is attributed to expectation on the part of buyers that freight rates will be reduced, but the hand-to-mouth buying that has characterized the market for many months could hardly be affected by such expectations, and it is more reasonable to assume that actual consumption has decreased or will decrease. Quotable prices are unchanged, but are becoming more or less nominal: Bessemer, \$20; basic, \$19; foundry, \$21, f.o.b. valley furnaces, with \$1.96 freight to Pittsburgh.

Connellsville coke is somewhat softer, by the double influence of continued light demand and softer conditions in coal. Spot furnace is \$3.25@3.35, contract furnace about \$3.40 and spot foundry \$4.25@4.75, depending on brand.

General Chemicals

CURRENT WHOLESALE PRICES IN NEW YORK MARKET

	Carlots	Less Carlots
Acetic anhydride.....lb.		\$0.40 - \$0.45
Acetone.....lb.	\$0.12 - \$0.12	13 - 13
Acid, acetic, 28 per cent.....100 lbs.	2.75 - 3.00	3.25 - 3.50
Acetic, 56 per cent.....100 lbs.	6.00 - 6.25	6.50 - 7.00
Acetic, glacial, 99 per cent, carboys, 100 lbs.	10.75 - 11.00	11.25 - 11.50
Boric, crystals.....lb.	12 - 13	13 - 14
Boric, powder.....lb.	13 - 13	14 - 14
Citric.....lb.		45 - 47
Hydrochloric.....100 lb.	1.25 - 1.50	1.60 - 1.75
Hydrofluoric, 52 per cent.....lb.	12 - 12	12 - 13
Lactic, 44 per cent tech.....lb.	09 - 10	10 - 12
Lactic, 22 per cent tech.....lb.	04 - 05	06 - 07
Molybde, C.P.....lb.	3.25 - 3.50	3.60 - 4.00
Muriatic, 20 deg. (see hydrochloric).....lb.		06 - 07
Nitric, 40 deg.....lb.	06 - 06	07 - 07
Nitric, 42 deg.....lb.	06 - 07	07 - 07
Oxalic, crystals.....lb.	12 - 13	13 - 14
Phosphoric, 50 per cent solution.....lb.	13 - 13	14 - 18
Picric.....lb.	20 - 25	27 - 35
Pyrogallol, resublimed.....lb.		1.90 - 2.00
Sulphuric, 60 deg., tank cars.....ton		11.00 - 12.00
Sulphuric, 60 deg., drums.....ton		13.00 - 15.00
Sulphuric, 66 deg., tank cars.....ton	17.00 - 18.00	
Sulphuric, 66 deg., drums.....ton	21.00 - 22.00	22.50 - 23.00
Sulphuric, 66 deg., carboys.....ton		
Sulphuric, fuming, 20 per cent (oleum) tank cars.....ton	21.00 - 22.00	
Sulphuric, fuming, 20 per cent (oleum) drums.....ton	23.00 - 23.50	24.00 - 24.50
Sulphuric, fuming, 20 per cent (oleum) carboys.....ton	31.00 - 32.00	33.00 - 34.00
Tannic, U. S. P.....lb.		75 - 85
Tannic (tech.).....lb.	45 - 48	50 - 55
Tartaric, imported crystals.....lb.		26 - 27
Tartaric acid, in p. rtd, powdered.....lb.		27 - 28
Tartaric acid, domestic.....lb.		35
Tungstic, per lb. of W.O.....lb.		1.10 - 1.20
Alcohol, Ethyl.....gal.		4.70 - 5.00
Alcohol, Methyl (see methanol).....gal.		
Alcohol, denatured, 168 proof.....gal.		37 - 38
Alcohol, denatured, 190 proof.....gal.		35 - 36
Alum, ammonia, lump.....lb.	03 - 03	04 - 04
Alum, potash, lump.....lb.	03 - 04	04 - 04
Alum, chrome lump.....lb.	10 - 11	11 - 12
Aluminum sulphate, commercial.....lb.	01 - 02	02 - 02
Aluminum sulphate, iron free.....lb.	02 - 02	03 - 03
Aqua ammonia, 26 deg., drums (750 lb.).....lb.	07 - 07	08 - 08
Ammonia, anhydrous, cyl. (100-150 lb.).....lb.	31 - 32	33 - 35
Ammonium carbonate, powder.....lb.	07 - 07	08 - 09
Ammonium chloride, granular (white sal ammoniac).....lb.	07 - 07	07 - 07
Ammonium chloride, granular (gray sal ammoniac).....lb.	07 - 07	07 - 07
Ammonium nitrate.....lb.	07 - 07	07 - 08
Amylacetate tech.....gal.		2.40 - 2.70
Arsenic oxide, (white arsenic) powdered lb.....lb.	06 - 06	06 - 07
Arsenic, sulphide, powdered (red arsenic) lb.....lb.	11 - 11	12 - 13
Barium chloride.....ton	63.00 - 64.00	65.00 - 66.00
Barium dioxide (peroxide).....lb.	20 - 21	22 - 23
Barium nitrate.....lb.	07 - 08	08 - 09
Barium sulphate (precip.) (blanc fixe) lb.....lb.	04 - 04	04 - 05
Bleaching powder (see calc. hypochlorite).....lb.		
Blue vitriol (see copper sulphate).....lb.		
Borax (see sodium borate).....lb.		
Bromine (see sulphur, roll).....lb.		
Bromine.....lb.	27 - 28	28 - 30
Calcium acetate.....100 lbs.	2.00 - 2.05	
Calcium carbide.....lb.	04 - 04	05 - 05
Calcium chloride, fused, lump.....ton	23.50 - 24.00	24.50 - 25.50
Calcium chloride, granulated.....lb.	01 - 02	02 - 02
Calcium hypochloride (bleach powder) 100 lbs.....lb.	2.25 - 2.30	2.35 - 3.00
Calcium peroxide.....lb.		1.40 - 1.50
Calcium phosphate, tribasic.....lb.		15 - 16
Camphor.....lb.		85 - 90
Carbon bisulphide.....lb.	06 - 06	07 - 07
Carbon tetrachloride, drums.....lb.	10 - 10	11 - 12
Carbonyl chloride, (phosgene).....lb.		60 - 75
Cautic potash (see potassium hydroxide).....lb.		
Cautic soda (see sodium hydroxide).....lb.		
Chlorine, gas, liquid-cylinders (160 lb.) lb.....lb.	08 - 09	09 - 10
Chloroform.....lb.		40 - 43
Cobalt oxide.....lb.		2.00 - 2.10
Coppers (see iron sulphate).....lb.		
Copper carbonate, green precipitate.....lb.	21 - 22	22 - 23
Copper cyanide.....lb.		50 - 62
Copper sulphate, crystals.....lb.	05 - 05	05 - 06
Cream of tartar (see potassium bitartrate).....lb.		
Epsom salt (see magnesium sulphate).....lb.		
Ethyl Acetate Com. 85%.....gal.		80 - 90
Ethyl Acetate pure (acetic ether, 98% to 100%).....gal.		95 - 100
Formaldehyde, 40 per cent.....gal.	11 - 11	11 - 12
Fusel oil, ref.....gal.		2.60 - 3.00
Fusel oil, crude.....gal.		1.50 - 1.75
Glauber's salt (see sodium sulphate).....lb.		
Glycerine, C. P. drums extra.....lb.		14 - 15
Iodine, resublimed.....lb.		3.50 - 3.60
Iron oxide, red.....lb.		12 - 18
Iron sulphate (copperas).....ton	18.00 - 19.00	20.00 - 23.00
Lead acetate.....lb.		10 - 12
Lead arsenate, paste.....lb.	09 - 09	10 - 11
Lead nitrate.....lb.		15 - 20
Litharge.....lb.	07 - 08	08 - 09
Lithium carbonate.....lb.		1.40 - 1.50
Magnesium carbonate, technical.....lb.	08 - 08	09 - 10
Magnesium sulphate, U. S. P.....100 lb.	2.50 - 2.75	
Magnesium sulphate, technical.....100 lb.		1.10 - 1.75
Methanol, 95%.....gal.		66 - 68
Methanol, 97%.....gal.		70 - 72
Nickel salt, double.....lb.		12 - 12
Nickel salt, single.....lb.		14 - 14
Phosgene (see carbonyl chloride).....lb.		
Phosphorus, red.....lb.	40 - 41	42 - 45
Phosphorus, yellow.....lb.		30 - 35
Potassium bichromate.....lb.	10 - 11	11 - 11

		Carlota	Less Carlota
Potassium bitartrate (cream of tartar)	lb.	\$.25	\$.25
Potassium bromide, granular	lb.	.15	.16
Potassium carbonate, U. S. P.	lb.	.04	.04
Potassium carbonate, 80-85%	lb.	.08	.08
Potassium chlorate, crystals	lb.	.06	.06
Potassium cyanide	lb.	.06	.06
Potassium hydroxide (caustic potash)	lb.	.07	.07
Potassium iodide	lb.	.18	.19
Potassium nitrate	lb.	.28	.29
Potassium permanganate	lb.	.20	.21
Potassium prussiate, red	lb.	.20	.21
Potassium prussiate, yellow	lb.	.20	.21
Rochelle salts (see sodium potas tartrate)			
Salammoniac (see ammonium chloride)			
Salt soda (see sodium carbonate)			
Salt cake (bulk)	ton	20.00	22.00
Silver cyanide	oz.	1.35	1.38
Silver nitrate	oz.	.46	.47
Soda ash light	100 lb.	2.10	2.15
Soda ash, dense	100 lb.	2.35	2.40
Sodium acetate	lb.	.04	.04
Sodium bicarbonate	100 lb.	2.00	2.25
Sodium bichromate	lb.	.08	.08
Sodium bisulphate (nitre cake)	ton	5.00	5.25
Sodium bisulphate powdered, U.S.P.	lb.	.04	.05
Sodium borate (borax)	lb.	.05	.06
Sodium carbonate (soda)	100 lb.	1.75	1.90
Sodium chl rate	lb.	.07	.07
Sodium cyanide	lb.	.27	.28
Sodium fluoride	lb.	.11	.12
Sodium hydroxide (caustic soda)	100 lb.	4.10	4.15
Sodium hyposulphite	lb.	.07	.07
Sodium nitrite	lb.	.07	.07
Sodium peroxide, powdered	lb.	.25	.26
Sodium phosphate, dibasic	lb.	.04	.04
Sodium potassium tartrate (Rochelle salts)	lb.	.14	.15
Sodium prussiate, yellow	lb.	.14	.15
Sodium silicate, solution (40 deg.)	100 lb.	1.00	1.15
Sodium silicate, solution (60 deg.)	100 lb.	.02	.02
Sodium sulphate, crystals (Glauber's salt)	100 lb.	1.50	1.75
Sodium sulphide, 60-62 per cent (conc.)	lb.	.04	.05
Sodium sulphite, crystals	lb.	.03	.03
Sodium sulphite, powdered	lb.	.12	.13
Sulphur chl ride, red	lb.	.05	.05
Sulphur, crude	ton	18.00	20.00
Sulphur dioxide, liquid, cylinders extra	lb.	.08	.08
Sulphur (sublimed), flour	100 lb.		2.25
Sulphur, roll (brimstone)	100 lb.		2.00
Tin bichloride, 50 per cent	lb.	.18	.19
Tin oxide	lb.		.37
Zinc carbonate, precipitate	lb.	.16	.16
Zinc chloride, gran.	lb.	.09	.09
Zinc cyanide	lb.	.42	.44
Zinc dust	lb.	.11	.11
Zinc oxide, XX	lb.	.07	.07
Zinc sulphate	100 lb.	3.00	3.25

Coal-Tar Products

NOTE—The following prices are for original packages in large quantities:

Alpha-naphthol, crude	lb.	\$1.15	\$1.20
Alpha-naphthol, refined	lb.	1.25	1.30
Alpha-naphthylamine	lb.	.27	.30
Aniline oil, drums extra	lb.	.17	.20
Aniline salts	lb.	.24	.26
Anthracene, 80% in drums (100 lb.)	lb.	.75	1.00
Benzaldehyde U.S.P.	lb.	1.35	1.45
Benzidine, base	lb.	.90	1.00
Benzidine sulphate	lb.	.75	.85
Benzoic acid, U.S.P.	lb.	.60	.65
Benzoate of soda, U.S.P.	lb.	.52	.55
Benzene, pure, water-white, in drums (100 gal.)	gal.	.27	.32
Benzene, 90%, in drums (100 gal.)	gal.	.25	.28
Benzyl chloride, 95-97%, refined	lb.	.25	.27
Benzyl chloride, tech.	lb.	.20	.23
Beta-naphthol benzoate	lb.	3.75	4.00
Beta-naphthol, sublimed	lb.	.70	.75
Beta-naphthol, tech.	lb.	.31	.34
Beta-naphthylamine, sublimed	lb.	1.75	1.85
Cresol, U. S. P., in drums (100 lb.)	lb.	.16	.17
Ortho-cresol, in drums (100 lb.)	lb.	.25	.27
Cresylic acid, 97-99%, straw color, in drums	gal.	.70	.80
Cresylic acid, 25-97%, dark, in drums	gal.	.65	.70
Cresylic acid, 50%, first quality, drums	gal.	.45	.50
Dichlorobenzene	lb.	.06	.09
Diethylaniline	lb.	1.10	1.20
Dimethylaniline	lb.	.45	.60
Dinitrobenzene	lb.	.23	.27
Dinitrochlorobenzene	lb.	.20	.25
Dinitronaphthalene	lb.	.30	.35
Dinitrophenol	lb.	.35	.40
Dinitrotoluene	lb.	.25	.30
Dip oil, 25%, ear lots, in drums	gal.	.30	.35
Diphenylamine	lb.	.60	.70
H-acid	lb.	1.05	1.15
Meta-phenylenediamine	lb.	1.15	1.20
Monochlorobenzene	lb.	.12	.14
Monothylaniline	lb.	1.65	1.70
Naphthalene crushed, in bbls.	lb.	.06	.08
Naphthalene, flake	lb.	.06	.08
Naphthalene, balls	lb.	.08	.09
Naphthionic acid, crude	lb.	.70	.75
Nitrobenzene	lb.	.12	.15
Nitronaphthalene	lb.	.30	.35
Nitro-toluene	lb.	.15	.17
Ortho-amidophenol	lb.	3.00	3.10
Ortho-dichlorobenzene	lb.	.15	.20
Ortho-nitro-phenol	lb.	.75	.80
Ortho-nitro-toluene	lb.	.15	.20
Ortho-toluidine	lb.	.20	.25
Para-amidophenol, base	lb.	1.40	1.45
Para-amidophenol, HCl	lb.	1.70	1.80
Para-dichlorobenzene	lb.	.12	.15
Paranitroaniline	lb.	.77	.80
Para-nitrotoluene	lb.	.80	.85
Para-phenylenediamine	lb.	1.70	1.75
Para-toluidine	lb.	1.25	1.40
Phthalic anhydride	lb.	.40	.50

Phenol, U. S. P., drums	lb.	.09	.12
Pyridine	gal.	2.00	3.50
Resorcinol, technical	lb.	1.50	1.60
Resorcinol, pure	lb.	2.00	2.25
Salicylic acid, tech., in bbls.	lb.	.18	.20
Salicylic acid, U. S. P.	lb.	.19	.22
Salol	lb.	.60	.70
Solvent naphtha, water-white, in drums, 100 gal.	gal.	.25	.28
Solvent naphtha, crude, heavy, in drums, 100 gal.	gal.	.14	.16
Sulphanilic acid, crude	lb.	.27	.30
Tolidine	lb.	1.30	1.35
Toluidine, mixed	lb.	.43	.45
Toluene, in tank cars	gal.	.25	.28
Toluene, in drums	gal.	.28	.31
Xylidines, drums, 100 gal.	lb.	.40	.45
Xylene, pure, in drums	gal.	.40	.45
Xylene, pure, in tank cars	gal.	.45	.50
Xylene, commercial, in drums, 100 gal.	gal.	.33	.35
Xylene, commercial, in tank cars	gal.	.30	.35

Waxes

Prices based on original packages in large quantities.

Bayberry Wax	lb.	\$0.21	\$0.22
Beeswax, refined, dark	lb.	.24	.25
Beeswax, refined, light	lb.	.28	.30
Beeswax, white pure	lb.	.36	.42
Candelilla wax	lb.	.24	.25
Carnauba, No. 1	lb.	.46	.47
Carnauba, No. 2, North Country	lb.	.24	.24
Carnauba, No. 3, North Country	lb.	.14	.15
Japan	lb.	.22	.22
Montan, crude	lb.	.04	.05
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb.	.03	.03
Paraffine waxes, crude, scale 124-126 m.p.	lb.	.02	.02
Paraffine waxes, refined, 118-120 m.p.	lb.	.03	.03
Paraffine waxes, refined, 125 m.p.	lb.	.03	.03
Paraffine waxes, refined, 128-130 m.p.	lb.	.03	.04
Paraffine waxes, refined, 133-135 m.p.	lb.	.04	.05
Paraffine waxes, refined, 135-137 m.p.	lb.	.05	.06
Stearic acid, single pressed	lb.	.09	.10
Stearic acid, double pressed	lb.	.10	.11
Stearic acid, triple pressed	lb.	.11	.11

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl.	280 lb.	\$5.70	5.79
Rosin E-I	280 lb.	5.70	5.85
Rosin K-N	280 lb.	6.30	6.75
Rosin W, G-W, W	280 lb.	7.10	7.30
Wood rosin, bbl.	280 lb.	6.25	
Spirits of turpentine	gal.	.81	
Wood turpentine, steam dist.	gal.	.79	
Wood turpentine, dest. dist.	gal.	.77	
Pine tar pitch, bbl.	200 lb.		6.50
Tar, kila burned, bbl. (500 lb.)	bbl.		10.00
Retort tar, bbl.	500 lb.		10.00
Rosin oil, first run	gal.	.35	
Rosin oil, second run	gal.	.37	
Rosin oil, third run	gal.	.44	
Pine oil, steam dist., sp.gr. 0.930-0.940	gal.		1.90
Pine oil, pure, dest. dist.	gal.		1.50
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.		.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.	gal.		.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
Pine tar, ref., thin, sp.gr. 1.080-1.060	gal.		.35
Turpentine, crude, sp.gr. 0.900-0.970	gal.		1.25
Hardwood oil, f.o.b. Mich., sp.gr. 0.960-0.990	gal.		.35
Pine wood creosote, ref.	gal.		.52

Solvents

73-76 deg., steel bbls. (85 lb.)	gal.	\$0.37
70-72 deg., steel bbls. (85 lb.)	gal.	.35
68-70 deg., steel bbls. (85 lb.)	gal.	.34
V. M. and P. naphtha, steel bbls. (85 lb.)	gal.	.23

Fertilizers

Ammonium sulphate, bulk and d. bags	100 lb.	\$2.70	3.00
Blood, dried, f.o.b., N. Y.	unit	4.00	
Bone, 3 and 50, ground, raw	ton	30.00	32.00
Cyanamide, f.o.b. works	unit	4.50	
Fish scrap, dom., dried, f.o.b. works	unit	2.90	3.00
Nitrate soda	100 lb.	2.35	2.45
Tankage, high grade, f.o.b. Chicago	unit	3.00	3.10
Phosphate rock, f.o.b. mines, Florida pebble, 68-72 p.c.	ton	4.50	6.50
Tennessee, 78-80 p.c.	ton	8.00	9.00
Potassium muriate, 80 p.c.	ton	37.00	40.00
Potassium sulphate	unit	1.15	1.20

Crude Rubber

Para-Upriver fine	lb.	\$0.21	.21
Upriver coarse	lb.	.11	.12
Upriver cauchol ball	lb.	.11	.12
Plantation—First latex crepe	lb.	.15	.15
Ribbed smoked sheets	lb.	.15	.15
Brown crepe, thin, clean	lb.	.15	
Amber crepe No. 1	lb.	.17	

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls.	lb.	\$0.10	\$0.10
Castor oil, AA, in bbls.	lb.	.11	.12
China wood oil, in bbls. (f.o.b. Pac. coast)	lb.	.09	.14
Cocanut oil, Ceylon grade, in bbls.	lb.	.10	.09
Cocanut oil, Ceylon grade, in bbls.	lb.	.10	.10
Corn oil, crude, in bbls.	lb.	.07	.07
Cottonseed oil, crude (f. o. b. mill)	lb.	.09	.09
Cottonseed oil, summer yellow	lb.	.09	.09
Cottonseed oil, winter yellow	lb.	.09	.10

Linseed oil, raw, ear lots (domestic).....	gal.	.67	—	.68
Linseed oil, raw, tank cars (domestic).....	gal.	.62	—	.63
Linseed oil, in 5-bbl lots (domestic).....	gal.	.70	—	.71
Olive oil, Denatured.....	gal.	\$1.15	—	\$1.20
Palm, Lagos.....	lb.	.07	—	.07
Palm, Niger.....	lb.	.06	—	.06
Peanut oil, crude, tank cars (f.o.b. mill).....	lb.	.08	—	.08
Peanut oil, refined, in bbls.....	lb.	.11	—	.11
Rapeseed oil, refined in bbls.....	gal.	.85	—	.87
Rapeseed oil, blown, in bbls.....	gal.	.92	—	.94
Soya bean oil (Manchurian), in bbls, N. Y.....	lb.	.09	—	—
Soya bean oil, tank cars, f.o.b., Pacific coast.....	lb.	.07	—	—

FISH

Light pressed menhaden.....	gal.	\$0.40	—	—
Yellow bleached menhaden.....	gal.	.42	—	—
White bleached menhaden.....	gal.	.45	—	—
Blown menhaden.....	gal.	.48	—	—

Miscellaneous Materials

All f.o.b. New York Unless Otherwise Stated

Barytes, ground, white, f.o.b. Kings Creek, S. C.....	net ton	\$24.00	—	30.00
Barytes, ground, off color, f.o.b. Kings Creek.....	net ton	20.00	—	24.00
Barytes, crude, 88% @ 94% ba., Kings Creek.....	net ton	10.00	—	12.00
Barytes, floated, f.o.b. St. Louis.....	net ton	23.00	—	24.00
Barytes, crude, first grade, Missouri.....	net ton	7.00	—	—
Blanco fixe, dry.....	lb.	.04	—	.04
Blanco fixe, pulp.....	net ton	45.00	—	55.00
Casein.....	lb.	.07	—	.10
Chalk, Precipitated, domestic, extra light.....	lb.	.04	—	.05
Chalk, Precipitated, domestic, light.....	lb.	.04	—	.04
Chalk, Precipitated, domestic, heavy.....	lb.	.03	—	.04
Chalk, Precipitated, English, extra light.....	lb.	.04	—	.05
Chalk, Precipitated, English, light.....	lb.	.04	—	.05
Chalk, Precipitated, English, dense.....	lb.	.04	—	.04
China clay (kaolin) crude, f.o.b. mines, Georgia.....	net ton	6.50	—	8.50
China clay (kaolin) washed, f.o.b. Georgia.....	net ton	9.00	—	10.00
China clay (kaolin) powdered, f.o.b. Georgia.....	net ton	13.00	—	20.00
China clay (kaolin) crude f.o.b. Virginia points.....	net ton	8.00	—	12.00
China clay (kaolin) ground, f.o.b. Virginia points.....	net ton	13.00	—	20.00
China clay (kaolin), imported, lump.....	net ton	12.00	—	20.00
China clay (kaolin), imported, powdered.....	net ton	25.00	—	30.00
Feldspar, crude, f.o.b. Maryland and North Carolina points.....	net ton	5.00	—	7.50
Feldspar, crude, f.o.b. Maine.....	net ton	7.50	—	10.00
Feldspar, ground, f.o.b. Maine.....	net ton	21.00	—	23.00
Feldspar, ground, f.o.b. North Carolina.....	net ton	17.00	—	21.00
Feldspar, ground, f.o.b. N. Y. State.....	net ton	17.00	—	21.00
Feldspar, ground, f.o.b. Baltimore.....	net ton	27.00	—	30.00
Fuller earth, f.o.b. Mines.....	net ton	16.00	—	17.00
Fuller earth, granular, f.o.b. Pa.....	net ton	15.00	—	18.00
Fuller earth, powdered, f.o.b. Pa.....	net ton	18.00	—	—
Fuller earth, imported, powdered.....	net ton	24.00	—	27.00
Graphite, Ceylon lump, first quality.....	lb.	.06	—	.07
Graphite, Ceylon chip.....	lb.	.04	—	.05
Graphite, high grade amorphous crude.....	lb.	.001	—	.02
Kieselguhr, f.o.b. mines, Cal.....	per ton	40.00	—	—
Kieselguhr, f.o.b. N. Y.....	per ton	55.00	—	60.00
Magnesite, calcined.....	per ton	60.00	—	65.00
Pumice stone, imported.....	lb.	.03	—	.40
Pumice stone, domestic, lump.....	lb.	.05	—	.05
Pumice stone, domestic, ground.....	lb.	.06	—	.07
Quartz (acid tower) first to head, f.o.b. Baltimore.....	net ton	—	—	10.00
Quartz (acid tower) 1 1/2 in., f.o.b. Baltimore.....	net ton	—	—	14.00
Quartz (acid tower) rice, f.o.b. Baltimore.....	net ton	—	—	17.00
Quartz, lump, f.o.b. North Carolina.....	net ton	5.00	—	7.50
Shellac, orange fine.....	lb.	.68	—	.70
Shellac, orange superfine.....	lb.	.80	—	.82
Shellac, A. C. garnet.....	lb.	.68	—	.60
Shellac, T. N.....	lb.	.68	—	.70
Soapstone.....	ton	12.00	—	15.00
Sodium chloride.....	long ton	12.50	—	13.00
Talc, paper-making grades, f.o.b. Vermont.....	ton	11.00	—	18.00
Talc, roofing grades, f.o.b. Vermont.....	ton	8.50	—	13.00
Talc, rubber grades, f.o.b. Vermont.....	ton	11.00	—	18.00
Talc, powdered, Southern, f.o.b. cars.....	ton	7.50	—	11.00
Talc, imported.....	ton	30.00	—	40.00
Talc, California talcum powder grade.....	ton	18.00	—	25.00

Refractories

Bauxite brick, 56% Al, f.o.b. Pittsburgh.....	per ton	\$50.00	—	—
Carborundum refractory brick, 9-in.	1,000	1250.00	—	—
Chrome brick, f.o.b. Eastern shipping points.....	net ton	52-55	—	—
Chrome cement, 40-45% Cr ₂ O ₃ , sacks, in ear lots, f.o.b. Eastern shipping points.....	net ton	33-35	—	—
Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works.....	1,000	35-40	—	—
Fireclay brick, 2nd quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works.....	1,000	30-35	—	—
Magnesite brick, 9-in. straight.....	net ton	65-70	—	—
Magnesite brick, 9-in. arches, wedges and keys.....	net ton	77	—	—
Magnesite brick, soaps and splits.....	net ton	98	—	—
Silica brick, 9-in. sizes, f.o.b. Chicago district.....	1,000	40-42	—	—
Silica brick, 9-in. sizes, f.o.b. Birmingham district.....	1,000	42-45	—	—
Silica brick, 9-in. sizes, f.o.b. Mt. Union, Pa.....	1,000	35-38	—	—

Ferro-Alloys

All f.o.b. Works

Ferro-titanium, 15-18%, f.o.b. Niagara Falls, N. Y.....	net ton	\$200.00	—	225.00
Ferrochrome per lb. of Cr. contained, 6-8% carbon, ear lots.....	lb.	.11	—	—
Ferrochrome per lb. of Cr. contained, 4-6% carbon, ear lots.....	lb.	.11	—	.12
Ferromanganese, 76-80% Mn, domestic.....	gross ton	58.00	—	60.00
Ferromanganese, 76-80% Mn, English & German.....	gross ton	60.00	—	62.00
Spiegeleisen, 18-22% Mn.....	gross ton	25.00	—	27.00
Ferromolybdenum, 30-60% Mo, per lb. of Mo.....	lb.	2.25	—	—
Ferrosilicon, 10-15%.....	gross ton	38.00	—	40.00
Ferrosilicon, 50%.....	gross ton	57.00	—	59.00
Ferrosilicon, 75%.....	gross ton	120.00	—	125.00
Ferrotungsten, 70-80%, per lb. of contained W.....	lb.	6.00	—	.45
Ferroumium, 35-50% of U, per lb. of contained U.....	lb.	6.00	—	—
Ferrovandium, 30-40% per lb. of contained V.....	lb.	4.25	—	4.50

Ores and Semi-finished Products

All f.o.b. New York, Unless Otherwise Stated

Bauxite, 52% Al content.....	net ton	\$8.00	—	\$10.00
Chrome ore, Calif. concentrates, 50% min. Cr ₂ O ₃	ton	23.00	—	25.00
Chrome ore, 50% Cr ₂ O ₃ , f.o.b. Atlantic seaboard.....	ton	23.00	—	25.00
Coke, foundry, f.o.b. ovens.....	net ton	4.25	—	4.50
Coke, furnace, f.o.b. ovens.....	net ton	3.25	—	3.50
Fluorspar, gravel, f.o.b. mines, New Mexico.....	net ton	15.00	—	—
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines.....	net ton	20.00	—	22.00
Ilmenite, 52% TiO ₂ , per lb. ore.....	lb.	.01	—	.01
Manganese ore, 50% Mn, c.i.f. Atlantic seaport.....	unit	.22	—	.23
Manganese ore, chemical (MnO ₂).....	net ton	50.00	—	55.00
Molybdenite, 85% MoS ₂ , per lb. of MoS ₂ , N. Y.....	lb.	.45	—	.50
Monazite, per unit of ThO ₂ , c.i.f. Atlantic seaport.....	unit	30.00	—	—
Pyrites, Spanish, fines, c.i.f. Atlantic seaport.....	unit	.12	—	.12
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport.....	unit	.13	—	.13
Pyrites, domestic, fines, f.o.b. mines, Ga.....	unit	.11	—	.12
Rutile, 95% TiO ₂ , per lb. ore.....	lb.	.15	—	—
Tungsten, scheelite, 60% WO ₃ and over, per unit of WO ₃ (nominal).....	unit	2.50	—	2.75
Tungsten, Wolframite, 60% WO ₃ and over, per unit of WO ₃ , N. Y. C.....	unit	2.75	—	3.00
Uranium ore (carnotite) per lb. of U ₃ O ₈	lb.	1.25	—	1.75
Uranium oxide, 96% per lb. contained U ₃ O ₈	lb.	2.25	—	2.50
Vanadium pentoxide, 99%.....	lb.	12.00	—	14.00
Vanadium ore, per lb. of V ₂ O ₅ contained.....	lb.	1.00	—	—
Zircon, washed, iron free, f.o.b. Pablo, Florida.....	lb.	.04	—	.13

Non-Ferrous Metals

New York Markets

Cents per Lb.

Copper, electrolytic.....	13.00
Aluminum, 98 to 99 per cent.....	24.50@25.00
Antimony, wholesale lots, Chinese and Japanese.....	4.90@5.25
Nickel, ordinary (ingot).....	41.00
Nickel, electrolytic.....	44.00
Monel metal, shot and blocks.....	35.00
Monel metal, ingots.....	38.00
Monel metal, sheet bars.....	40.00
Tin, 5-ton lots, Straits.....	27.87
Lead, New York, spot.....	4.65@4.70
Lead, E. St. Louis, spot.....	4.37@4.40
Zinc, spot, New York.....	5.05@5.10
Zinc, spot, E. St. Louis.....	4.60

OTHER METALS

Silver (commercial).....	oz.	\$0.70
Cadmium.....	lb.	1.00-1.25
Bismuth (500 lb. lots).....	lb.	1.50@1.55
Cobalt.....	lb.	3.00@3.25
Magnesium (f.o.b. Philadelphia).....	lb.	1.25
Platinum.....	oz.	85.00
Iridium.....	oz.	150.00@170.00
Palladium.....	oz.	60.00
Mercury.....	75 lb.	38.00-39.00

FINISHED METAL PRODUCTS

Warehouse Price

Cents per Lb.

Copper sheets, hot rolled.....	20.50
Copper bottoms.....	28.00
Copper rods.....	19.00@19.75
High brass wire.....	15.75
High brass rods.....	13.25
Low brass wire.....	17.25
Low brass rods.....	17.25
Brazed brass tubing.....	25.00
Brazed bronze tubing.....	29.75
Seamless copper tubing.....	19.50
Seamless high brass tubing.....	18.00

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	New York Current	Cleveland	Chicago
Copper, heavy and crucible.....	9.50@10.00	9.25	9.50
Copper, heavy and wire.....	9.00@9.25	8.50	8.50
Copper, light and bottoms.....	7.50@8.00	7.50	7.25
Lead, heavy.....	3.25@3.50	3.25	3.25
Lead, tea.....	2.25@2.35	2.25	2.25
Brass, heavy.....	4.25@4.50	4.50	5.00
Brass, light.....	3.25@3.50	3.25	3.50
No. 1 yellow brass turnings.....	4.00@4.25	4.25	4.50
Zinc.....	2.00@2.25	2.00	2.25

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by 1/2 in. and larger, and plates 1/2 in. and heavier, from jobbers' warehouses in the cities named:

	New York	Cleveland	Chicago
Structural shapes.....	\$2.88	\$2.88	\$2.88
Soft steel bars.....	2.78	2.78	2.78
Soft steel bar shapes.....	2.78	2.78	2.78
Soft steel bands.....	3.42	3.48	3.48
Plates, 1/2 to 1 in. thick.....	2.88	2.88	2.88

*Add 15¢ per 100 lb. for trucking to Jersey City and 10¢ for delivery in New York and Brooklyn

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Alabama

GADSDEN—The Gadsden Clay Products Co. will build an addition to its plant, to be equipped for the manufacture of pressed bricks and other burned clay products. Work is now under way on the construction of three new kilns.

TUSCALOOSA—The proposed new company to be organized under the direction of the Industrial Committee of the local Chamber of Commerce, J. B. Brosius, secretary, for the construction and operation of a local pulp and paper mill, will be capitalized at \$2,000,000. Details of the new company and plant are being arranged.

Arkansas

EL DORADO—The Grison Refining Co. has construction under way on a new oil refinery. It is planned to establish a gasoline-producing plant in connection with the new works.

California

LOS ANGELES—The Western Pipe & Steel Co., 1670 North Broadway, has plans under way for the erection of a large plant on a 23-acre site of land acquired at Santa Fe and Slauson Aves. It will consist of a number of buildings for general steel products manufacture.

Connecticut

NEW BRITAIN—The Donnelly Brick Co. has awarded a contract to the William H. Allen Co., Inc., Hungerford Court, for the rebuilding of its plant, recently destroyed by fire. The new works will consist of a number of buildings, including drier department, tunnel kiln building, machine room and other mechanical branches.

Delaware

WILMINGTON—The Martin Leather Co., 701 East 5th St., has filed plans for the erection of a new 2-story building on East 5th St., near Spruce St., 47 x 60 ft. The company recently increased its capital from \$700,000 to \$1,500,000.

Florida

MARIANNA—The Egyptian Syrup & Production Co. recently organized has plans under way for the erection of a new sugar mill, with daily output of about 400 tons of cane sugar to be used for the manufacture of cane sirup and kindred products. The plant is estimated to cost about \$150,000 with equipment. Larkin & Pratt, Arcade Bldg., St. Louis, Mo., are architects. J. N. Nicolay heads the company.

TAMPA—The Southern Bottle Mfg. Co., recently organized with a capital of \$1,500,000, has awarded a contract to the Oatley-Jones Co., Tampa, for the erection of its proposed new plant at Gary, near Tampa. It will be 1-story, 60 x 150 ft., and will be equipped for daily capacity of about 150 gross of milk bottles, jelly glasses, etc. An adjoining building, 36 x 62 ft., will also be constructed. I. F. Jones is president.

KENDAL—The A. B. Hurst Co., recently organized, is arranging for the establishment of a local plant for the manufacture of starch products. It is proposed to develop a capacity of about 3,000 lb. per day. J. B. Hurst is secretary, and W. T. Tomlinson, vice-president and engineer.

Georgia

ATLANTA—The Simmons Plating Works, manufacturer of plated metal products, is planning for the erection of a 2-story addition to its plant for nickel plating and other operations. New machinery will be installed.

Illinois

CHICAGO—Work has been completed on the new gas plant of the People's Gas Light & Coke Co., 122 South Michigan Boulevard, said to represent an investment in excess of \$15,000,000. The plant is constructed in two sections, providing for the production both of coal and water gas. The first noted has a capacity of 14,000,000

cu.ft. per day, and the latter section 26,000,000 cu.ft. daily. The plant will be placed in operation at once.

Kentucky

LEXINGTON—The Great Southern Refining Co. has taken over an oil refinery at Pryse (Estill County), Ky., and will operate the plant in connection with its Lexington refinery. The combined output will total about 4,000 bbl. per day. W. B. Hasset is president, and Paul Blazer, vice-president.

Maryland

BALTIMORE—The Virginia-Carolina Chemical Co., 11 South 12th St., Richmond, Va., has plans under way for the erection of its proposed new fertilizer manufacturing plant at Baltimore, to be 200 x 500 ft., and estimated to cost in excess of \$3,000,000, including machinery. It is planned to commence erection early in the coming year. S. D. Grenshaw is secretary.

Massachusetts

SALEM—The Peerless Leather Co. has acquired the local plant of the Broadley Co., and will establish a new tannery. It is proposed to commence operations at an early date. Machinery will be installed at once.

Michigan

CHASSELL—The Michigan Humus & Chemical Co., has been reorganized as the National Humus & Chemical Co., with capital of \$1,000,000. The company is planning to increase its operations for the manufacture of fertilizer and powdered fuel, and a local works will be established for this purpose. C. F. Hancock is president.

Mississippi

MERIDEN—The Bang-Go Soap Mfg. Co., 2304 Front St., recently organized, is planning for the erection of a new local plant for the manufacture of soap products. R. E. Yarbrough is president, and L. L. Gunn, general manager.

Missouri

KANSAS CITY—The American Gasoline Corp. has work under way for extensions and improvements in the local refinery of the North American Refining Co., known as the Sheffield plant, recently acquired. New process stills and other equipment will be installed, and it is expected to have the works ready for service before the first of the year. The refinery will have a capacity of 4,000 bbl. of oil per day, with lubricating oil works to have an output of 300 bbl. daily.

New Jersey

TRENTON—The Acme Sanitary Pottery Co., May St., manufacturer of sanitary earthenware, has awarded a contract to Solan & Dotter, Inc., for the erection of a 2-story, brick addition, 30 x 128 ft., with new 1-story building adjoining, 18 x 60 ft.

TRENTON—The New Jersey Porcelain Co., Pennsylvania Ave. and Mulberry St., has filed plans for the erection of a new 3-story brick building at its plant.

MILLINGTON—The Asbestos Material Corp. has acquired the plant of the Bateman Co., on Central Ave., heretofore devoted to the manufacture of agricultural implements, for a new plant for the manufacture of asbestos products. The building is 2-story, concrete; possession will be taken at once and necessary equipment installed. It is said that employment will be given to about 70 persons for initial operations.

New York

EAST HAMBURG—Fire Oct. 26 destroyed the plant of the Electro-Refractory Co., Townline Road, manufacturer of steel crucibles, etc., with loss estimated at about \$200,000, of which about \$50,000 represents machinery. Headquarters of the company are at Ellicott Sq., Buffalo, N. Y.

SPARKILL—The Standard Oil Co., 26 Broadway, New York, has taken title to a tract of property totaling about 1,500 acres, in the vicinity of Sparkill and Palsade, N. Y., for a consideration stated at \$2,000,000, and is reported to be planning to use the site for a new oil works.

Ohio

WEST PARK—A. & S. Paint & Varnish Co., Elmwood Ave., has awarded a contract to the George A. Rutherford Co., 2729 Prospect Ave., for the erection of a new 3-story and basement plant, 50 x 70 ft., on Elmwood Ave., estimated to cost about \$45,000. Work will be placed under way at once. A. J. Ferbert is manager.

NEWTON FALLS—The Hubbell Tire & Rubber Co., 6545 Carnegie Ave., Cleveland, has acquired the plant of the Trumbull Tire & Rubber Co., Newton Falls, and will use the property for a branch plant. Machinery will be installed at once and production inaugurated at an early date.

EAST PALESTINE—The National Fireproofing Co., Fulton Bldg., Pittsburgh, Pa., has plans under way for the rebuilding of its plant at East Palestine, to replace the portion destroyed by fire. It will be 1-story, 100 x 100 ft., and is estimated to cost about \$60,000. Sidney F. Heckert, Bessemer Bldg., Pittsburgh, is architect.

Oregon

PORTLAND—The Oregon Brass Works, North Second St., has awarded a contract to Camp & DuPuy, East Adler St., for the erection of a new 1-story foundry addition.

Pennsylvania

PHILADELPHIA—The Pennsylvania Sugar Co., North Penn St., has added to its recent property purchases in the vicinity of its plant on North Delaware Ave., and has acquired the factory of the American Preserve Co., 946-54 North Delaware Ave., 72 x 105 ft., for a consideration said to be \$55,000. The property will be used for expansion.

Texas

WACO—The Waco Refining Co. is planning for the construction of additions to its plant for increased production. The refinery is located in the East Waco district, and was acquired recently by W. A. Rogers and associates. Mr. Rogers is president.

MEXIA—Following the acquisition of an extensive interest in the Humphreys-Mexia Co. and the Humphreys-Texas Co. by the Pure Oil Co., 74 Broadway, New York, said to involve a consideration of \$7,000,000, plans are being prepared for extensions in the properties. A new central oil-collecting and distributing plant will be constructed near Galveston, Tex., with new 130-mile pipeline, estimated to cost about \$3,500,000. A site will be selected at a Gulf Coast point at an early date for the erection of a new oil refinery to cost in excess of \$1,000,000.

Virginia

ALEXANDRIA—Fire Oct. 24 destroyed the plant of the Belle Pre Glass Co., in the northwestern section of the city, with loss estimated at about \$50,000. It is said that the plant will be rebuilt.

Washington

SPOKANE—The Consolidated Diamond Oil Refining Co. has acquired property at Dishman, near Spokane, and contemplates the construction of a new refinery on the site.

Capital Increases, Etc.

THE MARINETTE & MENOMINEE PAPER Co., Marinette, Wis., has disposed of a bond issue of \$2,000,000, to be used for financing general operations, etc.

THE DEGRASSE PAPER Co., Pyrites, N. Y., has filed notice of increase in capital from \$1,000,000 to \$4,000,000.

THE NEW ENGLAND TIRE & RUBBER Co., Holyoke, Mass., has filed notice of increase in capital from \$3,000,000 to \$53,000,000.

THE MAY FOUNDRY Co., Sixty-first and Eastwick Sts., Philadelphia, Pa., has filed notice of increase in capital from \$565,000 to \$10,500,000.

THE CENTRAL STEEL Co., Masillon, Ohio, has arranged for a bond issue to total \$5,000,000.

THE MARDEN, ORTH & HASTINGS Co., Boston, Mass., operating under a receivership since April last, has been acquired by Hunnell & Co., Inc., a new organization, composed of former employees of the company. Offices will be established at 310 Congress St., and operations conducted in the line of chemicals, tanning materials, oils, etc., as heretofore. L. C. Hunnell is president, and G. Warren Heath, treasurer.

THE TUSKELOID Co., 114 East 16th St., New York, manufacturer of composition specialties, has filed notice of increase in capital from \$50,000 to \$100,000.

New Companies

THE DIAMOND SOAP Co., Wilmington, Del., has been incorporated under Delaware laws with capital of \$200,000, to manufacture soaps and kindred products. The company is represented by Artemus Smith, Ford Bldg., Wilmington.

THE DETROIT SAND LIME BRICK Co., 507 Vinton Bldg., Detroit, Mich., has been incorporated with a capital of \$350,000, to manufacture bricks and other sand-lime products. The company has plans under way for the erection of a new local plant. The incorporators are F. William Niemann, Reinhold Polte and Albert H. Meinke.

THE WYEMOUTH CUT GLASS Co., Hammononton, N. J., has been incorporated with a capital of 100 shares of stock, no par value, to manufacture glass products. The incorporators are David Ford, John F. Rithfus and Charles H. Strunk, Hammononton.

THE PENNSYLVANIA LEAD & ZINC Co., Allentown, Pa., has been incorporated under Delaware laws with a capital of \$1,500,000, to operate zinc, lead and other similar mining properties. The incorporators are Horace B. Hemingway and George N. Schaffer, Allentown; and Philip R. Berg, Catasauqua, Pa. The company is represented by the United States Corporation Co., 65 Cedar St., New York.

THE GENERAL PACKING & RUBBER Co., INC., 28 South Charles St., Baltimore, Md., has been incorporated with a capital of \$10,000, to manufacture rubber products of various kinds. The incorporators are Zachary R. Lewis, Eben J. D. Cross and E. Ridgely Simpson.

THE HERCULENE OIL & REFINING CORP., New York, N. Y., has been incorporated with a capital of \$100,000, to manufacture refined oil products. The incorporators are J. M. Shellabarger, J. J. Donovan and E. A. Walsh. The company is represented by Shellabarger & Donovan, 30 Church St., New York.

THE NATIONAL WOODSTAINING CORP., Elizabeth, N. J., has been incorporated with a capital of \$50,000, to manufacture stains, paint specialties, etc. The incorporators are George Seebler, Carl F. Guntrum and Wilhelm Koch, 1191 East Grand St., Elizabeth.

THE EDCO OIL Co., Philadelphia, Pa., is being organized by E. M. and Edward J. Cook, and Daniel A. McKendry, to manufacture petroleum products, lubricating oils, etc. Application for a state charter will be made on Nov. 14. The company is represented by Johnson & Gilkyson, 1211 Chestnut St., Philadelphia.

THE STAINLESS PRODUCTS CORP., Watervliet, N. Y., has been incorporated with a capital of \$20,000, to manufacture metal alloys of various kinds. The incorporators are R. P. and Z. M. Devries, and J. Cran. The company is represented by C. Friend, attorney, Albany, N. Y.

HIRD & CONNOR, INC., Boston, Mass., has been incorporated with a capital of \$30,000, to manufacture chemical products. Frederic C. Van Norman is president; and M. T. Cronin, Medford, Mass., is treasurer.

THE WOODSTOWN PRESS BRICK Co., Woodstown, N. J., has been incorporated with a capital of \$150,000, to manufacture brick, tile and other ceramic products. The company is represented by the N. J. Corporation Guarantee & Trust Co., 419 Market St., Camden, N. J.

THE HANS HINRICHS CHEMICAL CORP., New York, N. Y., has been incorporated with a capital of \$75,000, to manufacture chemicals and chemical byproducts. The incorporators are R. B. Bradley, W. F. Elising and W. J. Rose, 27 William St.

THE SERVUS RUBBER Co., 38 South Dearborn St., Chicago, Ill., has been incorporated with a capital of \$500,000, to manufacture rubber products. The incorporators are Hasbrouck Haynes, Cornelius Lynde and Howard W. Lewis.

THE CORODIUM STEAM PRESSED BRICK Co., Pontiac, Mich., has been incorporated with a capital of \$100,000, to manufacture brick, tile and other burned clay products. The incorporators are Cassius J. Crawford and Roy C. Jenne, Pontiac; and Leon F. Owen, Sylvan Lake, Mich.

THE GOTHAM ASBESTOS & MINERALS Co., New York, N. Y., has been incorporated with a capital of \$25,000, to manufacture asbestos products and affiliated specialties. The incorporators are M. L. Hamburger, E. Goodman and J. J. Lazaros, 25 West 42d St.

THE OSANTOS CHEMICAL Co., 110 South Dearborn St., Chicago, Ill., has been incorporated with a capital of 400 shares of stock, no par value, to manufacture chem-

icals and chemical byproducts. The incorporators are F. W. Metz, A. M. Domber and Guy H. Powell.

THE UNION HILL MIRROR & GLASS WORKS, INC., Union Hill, N. J., has been incorporated with a capital of \$50,000, to manufacture glass products. The incorporators are Samuel Gross, Andrew Darion and Paul Doppler, 404 Main St., Union Hill.

THE CONNECTICUT HARD RUBBER Co., New Haven, Conn., has been incorporated with a capital of \$10,000, to manufacture rubber products. The incorporators are A. A. Smith, J. A. Moffitt and William Baxter, 71 Sea St., New Haven.

THE CONSUMERS' OIL & GREASE Co., Reno, Pa., has been incorporated under Delaware laws, with a capital of \$100,000, to manufacture oils, greases and kindred products. The incorporators are Forest A. Huff, W. W. Turner and W. M. Huff, Reno. The company is represented by the Corporation Service Co., Wilmington, Del.

THE K. B. OIL CORP., Buffalo, N. Y., has been incorporated with a capital of \$300,000, to manufacture oil products. The incorporators are J. H. Tiedemann, and J. A. Clausen. The company is represented by C. D. Coyle, 168 Franklin St., Buffalo.

THE RIVER FOUNDRY Co., Detroit, Mich., has been incorporated with a capital of \$5,000, to manufacture steel and alloy castings. The incorporators are Robert Baehman and Joseph C. Arnold, 341 Kitchener St., Detroit.

THE STORM WATERPROOFING CORP., New York, N. Y., has been incorporated under Delaware laws with capital of \$200,000, to manufacture paints and waterproofing compounds. The incorporators are A. K. Dohrman, Eugene E. and Charles R. Allison, New York. The company is represented by the Capital Trust Co., Dover, Del.

THE RED SEAL REFINING Co., Los Angeles, Cal., has been incorporated with a capital of \$500,000, to manufacture refined petroleum products. The incorporators are H. L. Hagerman, O. A. Burchard and D. S. Fridner. The company is represented by I. W. Bull, 817 Central Bldg., Los Angeles.

THE BOND CHEMICAL PRODUCTS CORP., Wilmington, Del., has been incorporated under state laws, with capital of \$100,000, to manufacture chemicals and chemical byproducts. The company is represented by the Colonial Charter Co., Ford Bldg., Wilmington.

Industrial Notes

THE AUSTIN MACHINERY CORP. announces that the Canadian Austin Machinery Co., Ltd., Woodstock, Ont., incorporated under the laws of Canada, will henceforth act as sole manufacturer and distributor in Canada of the complete Austin line of earthmoving and concrete machine equipment. The manufacture of Austin machinery at Woodstock enables the Canadian company to supply economically its line of equipment and furnish service in maintenance.

WURSTER & SANGER, chemical engineers, announce the opening of offices at 5201 Kenwood Ave., Chicago, where they will be engaged in both consulting and construction work relating to the manufacture of soap, fatty acid distillation plants and glycerine plant equipment. Oscar H. Wurster has had long experience in plants of this sort, having been employed by M. Work Co., Lever Bros., Ltd., Morris & Co., packers, and the Louisville Soap Co. Walter E. Sanger was formerly chemical engineer with Swift & Co., packers, and the Procter & Gamble Soap Co.

L. O. KOVEN & BRO., Jersey City, celebrated its fortieth anniversary Sept. 28. A dinner was given at the company's cafeteria. The entire office force and a few outside friends were present. A number of interesting speeches on the history of the company were delivered.

L. C. BIGLOW & Co., Inc., 232 West 55th St., New York City, has been appointed New York district agent for the Hartford Tap & Gauge Co., the Hanson-Whitney Machine Co., Inc., the Taylor & Fenn Co. and the Whitney Mfg. Co., all of Hartford, Conn.

BRITISH FURNACES, LTD., Millbank House, 2 Wood St., London, S. W. 1, England, with an authorized capital of £25,000 was organized during the early part of July, this year, for the purpose of manufacturing and selling Surface Combustion apparatus in the British Empire. The principal stockholders consist of the Bryan-Donkins Co., Ltd., machinist and founder, Chesterfield, England; Woodall, Duckham & Jones, Ltd., engineer and manufacturer, London, England, and the Surface Combustion Co., Inc., Bronx, New York, owner of the surface

combustion patents and manufacturer of industrial furnaces. The Surface Combustion Co., Inc., is now represented in all the principal European countries and many large industrial furnace installations have already been made. The Compagnie Générale de Construction de Four, Paris, France, is the sole licensee and manufacturer for Surface Combustion patented apparatus in France and its colonies, Belgium, Holland, Switzerland, Italy, Spain and Portugal. John H. Bartlett, Jr., foreign representative for the Surface Combustion Co., Inc., of New York, has had charge of this work during the last few years and personally supervised the organizing of the foreign sales and manufacturing departments for the companies which took over the Surface Combustion Co. rights.

THE AMERICAN BOSCH MAGNETO CORP. has recently appointed new managers in its New York and Detroit branches. George Shortmeier, formerly New York manager for the Madison Rubber Co. and later district manager at New York for the Sinclair Oil Co., has been placed in charge of the Bosch branch at New York, replacing O. S. Stanley. Charles L. Shedd is now manager of the Bosch branch at Detroit, taking the place of Roy Davey, who has been made manager of the manufacturing sales department at Springfield, Mass. Mr. Shedd was at one time promotion manager of the truck division of the Packard Motor Car Co. at Detroit, subsequently served as official distributor at Omaha for that company and still more recently acted as sales manager of the Republic Truck Corp. at New York City.

THE BLAW-KNOX Co., Pittsburgh, Pa., announces the addition of H. O. Davidson to its staff. Mr. Davidson will have entire charge of the Prudential Sectional Building Department and will also be general manager of the C. D. Pruden plant of the Blaw-Knox Co. at Baltimore, Md. Mr. Davidson was connected for eight years with the Hydraulic Steelcraft Co., being general manager of that organization at the time he severed his connections to become a member of the Blaw-Knox staff.

JOHN F. ABERNETHY have moved to new offices and shops at 708-10 Myrtle Ave., Brooklyn, N. Y.

C. H. BOLEY & Co., Inc., manufacturing industrial chemist of Philadelphia, Pa., announces the addition on Sept. 1 of T. Perry Rider, as sales manager. Mr. Rider was for many years connected with Schofield, Mason & Co., Philadelphia, Pa.

EDWARD O. BENJAMIN recently moved his offices to 530 Park Row Bldg., New York, continuing the practice of consultation, research and testing of apparatus and material relating to electrochemical welding, industrial gases, oil, rubber and allied industries.

Coming Meetings and Events

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE will hold its seventy-fourth meeting at Toronto, Canada, Dec. 27 to 31, 1921.

AMERICAN CERAMIC SOCIETY will hold its twenty-fourth annual meeting at St. Louis, Feb. 27 to March 2, 1922.

AMERICAN ENGINEERING COUNCIL will hold its next meeting in Washington, Jan. 5-6.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its annual winter meeting at Baltimore, Md., Dec. 6 to 9. Headquarters will be at the Southern Hotel and the sessions will be held in the Engineers' Club.

AMERICAN IRON AND STEEL INSTITUTE will hold its twentieth general meeting at the Hotel Commodore, New York City, on Friday, Nov. 18.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stettens Restaurant, 342 Broad St., Newark, N. J., the second Monday of every month.

STAMFORD CHEMICAL SOCIETY, Stamford, Conn., holds a meeting in the lecture room of the local high school on the fourth Monday of each month, except June, July, August and September.

The following meetings are scheduled to be held in Rumford Hall, the Chemists' Club, New York: Nov. 11—American Chemical Society (in charge), Society of Chemical Industry, American Electrochemical Society, Société de Chimie Industrielle, joint meeting; Nov. 18—American Electrochemical Society, regular meeting; Dec. 2—Society of Chemical Industry, regular meeting; Dec. 9—American Chemical Society regular meeting.